DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

SEP 07 2018

Colonel Richard W. Gibbs, USAF
Commander
377th Air Base Wing
2000 Wyoming Blvd SE
Kirtland AFB NM 87117

Mr. John Kieling, Bureau Chief
Hazardous Waste Bureau (HWB)
New Mexico Environment Department (NMED)
2905 Rodeo Park Drive East, Building 1
Santa Fe NM 87505-6303

Dear Mr. Kieling

Attached please find the *Bioventing Respiration Pilot Testing Procedure* for the Bulk Fuels Facility, Solid Waste Management Unit (SWMU) ST-106/SS-111, Kirtland Air Force Base, New Mexico, dated September 2018. This procedure has been prepared to summarize the field details of the testing approach approved in the *Work Plan for Bioventing and Air-lift Enhanced Bioremediation Pilot Test, Bulk Fuels Facility, Solid Waste Management Unit (SWMU) ST-106/SS-111, Kirtland Air Force Base, New Mexico, dated November 2017.*

If you have any questions or concerns, please contact Mr. Scott Clark at (505) 846-9017 or at scott.clark@us.af.mil or Mr. Sheen Kottkamp at (505) 846-7674 or at sheen.kottkamp.1@us.af.mil.

Sincerely

Richard W. Gibbs

RICHARD W. GIBBS, Colonel, USAF
Commander

cc:
NMED (Borrego) letter
NMED-OOTS (McQuillan), letter and CD
NMED GWQB (Hunter), letter and CD
EPA Region 6 (King, Ellinger), letter and CD
SAF-IEE (Lynnes), electronic only
AFCEC/CZ (Renaghan, Clark, Kottkamp, Segura), electronic only
USACE-ABQ District Office (Moayyad, Phaneuf, Dreeland, Cordova, Salazar), electronic only
Public Info Repository, Administrative Record/Information Repository (AR/IR) and File

Bioventing Respiration
Pilot Testing Procedure

Revision 0
September 2018

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DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
0	9/5/2018	Bioventing Respiration Pilot Testing Procedures	Tyler Curley	Dr. Rob Hinchee Dr. Bruce Alleman

1. SCOPE AND APPLICATION

The bioventing respiration pilot test, field data collection, and analytical laboratory sample collection methodology are described in the following document. The area where the bioventing respiration pilot test will be performed is shown on Figure 1. The field area and test wells for the bioventing respiration pilot test are shown on Figure 2.

The bioventing respiration testing will allow for verification of the design parameters estimated in the respiration testing. Data collected from the testing will assist with the assessment of the sustainability of biodegradation rates over a longer period of time. Three tests are envisoned: (1) "dry" respiration tests, wherein ambient air is vented into the impacted zone in sufficient quantity to measure oxygen utilization (i.e., decline in oxygen content of "test cell," by bacterial respiration); (2) "moist" respiration test wherein water is added to the subsurface to stimulate bacteria, and oxygen utilization measured; and (3) a long-term bioventing test wherein multiple wells are vented simultaneously for more than a year and respiration is monitored in observation wells at a distance.

The test layout, test wells, bioventing equipment and instrumentation, measurement of field parameters, and analytical chemistry regimen are discussed herein and provided in the figures, tables, and attachments. Design parameters obtained during the respiration test shall be utilized to design the long-term bioventing pilot test.

2. BIOVENTING TEST WELLS

The respiration testing utilizes nine existing soil vapor extraction wells and soil vapor monitoring (SVM) wells for air injection. Two new nested SVM wells will be installed to monitor pressure and subsurface parameters (Table 1). Well locations are shown on Figure 2. The new SVM wells (KAFB-106V1 and KAFB-106V2) include multiple screen depths to facilitate discrete vertical monitoring of the vadose zone. The designs for KAFB-106V1 and KAFB-106V2 bioventing observation wells are provided in Figures 3 and 4. KAFB-106V1 and KAFB-106V2 locations were specified for the long-term bioventing pilot test to be used as observation wells as the injection wells will be under continuous operation. These observations wells are intended for use during short-term respiration tests to obtain pressure measurements only. The respiration tests are designed to be "single well" tests.

The wells selected for air injection vary in size from 0.5 to 4 inches in diameter. Table 1 also provides radial distances from air injection wells to nearby existing wells suitable for use as observation wells during the long-term bioventing test. Completion diagrams for the existing air injection and observation wells are provided in Attachment A.

The construction details, diameters, and open intervals for the designated air injection wells are provided in Table 2, along with the air injection rate and nominal pipe velocity. Test cell pore volume is calculated using a filter pack length (plus 5 feet above and below to account for leakage) and a control radius of 15 feet. The control radius is the radial distance from the injection well to the edge of the cylindrical test cell. The control radius is utilized to establish the

test cell pore volume, and thus the volume of air to be injected. The test cell volume is expected to be large enough so that sampling subsequent to air injection will measure only oxygen depletion in injected air, not ambient soil vapor which could intrude into the test cell.

3. BIOVENTING INSTRUMENTATION

Air will be injected with a blower capable of 50 cubic feet per minute (cfm) at 3 psi. The unit will be plumbed and configured for use in injection mode. A piping and instrumentation diagram of the air injection test equipment is provided as Figure 5. Other features of the bioventing system include:

- Direct reading rotameters and pressure gauges that control flow rates on individual manifold legs and the header
- Schedule 80 polyvinyl chloride header and manifold
- One-inch diameter compressed air hose conveyance line that will connect the blower to the header
- Quick-connect fittings at the manifold and wellheads to facilitate air injection or well sampling
- Electrical service providing 120-volt single phase power, as well as a 230-volt, 3-phase power connection.

4. PROCEDURE

4.1 DRY RESPIRATION TEST

"Dry" respiration tests consist of the injection of ambient air into a well sufficient to achieve the estimated pore volume of air (porosity assumed to be 35 percent [%]). A 15-foot radius from the injection well is assumed for the calculation of each test cell control volume. The thickness of each test cell control volume is equal to the filter pack length, plus 5 feet above and below to account for vertical air flow. The injection rate is calculated based on the addition of four pore volumes of the test cell in each well. Injection rates for each well are provided in Table 2. Air injection is monitored and controlled using rotameters located at the injection wellhead. Injection flow rates and pressure are recorded at each well. Injection will occur at all well locations simultaneously.. The injection periods is expected to last 3 days . If injection rates are lower than anticipated, the injection duration will be increased to maintain the specified volume of injection air.

During the air injection phase of the tests, pressure radius of influence (ROI) monitoring is performed using nearby wells not used for injection (see Table 1). If pressures can be measured, then estimates of pressure ROI monitoring provide an estimate of both the soil and soil vapor

permeability and the ROI to which pressure can be measured. A digital monometer capable of detecting 0.1 inches of water column is used to monitor the pressure response at the nearby wells to establish the ROI. However, given the permeable nature of the soil and distances to monitoring points, measurable pressure may not be found. ROI will also be estimated utilizing the respiration test data based on oxygen demand.

After the air is injected, field parameter readings for water activity, pressure, carbon dioxide, oxygen, total petroleum hydrocarbons, methane, flow rate, and temperature are collected in accordance with frequency indicated in Table 3. Soil vapor samples are collected using the method described in the approved work plan (U.S. Army Corps of Engineers [USACE], 2017) and submitted to Eurofins Air Toxics, Inc. (EAT), Folsom, California for the analytes listed in Table 4. A piping and instrumentation diagram of the soil vapor sampling setup is provided in Figure 6.

4.2 MOIST RESPIRATION TEST

After the "dry" respiration tests have been completed, water is injected into each test well under pressure (to the degree practicable). The water is radially forced into the formation. The specified amount of water added is 1% of the treatment cell pore volume. This volume of water is estimated to be (for a 15-foot radius and 35% porosity) equal to 2.5 cubic feet (19 gallons) per foot of treatment cell height. Thus, 2.5 cubic feet of water is added to a per foot unit test cell pore volume of 247 cubic feet. This relatively minimal volume is not anticipated to alter the formation geochemistry or cause contaminant migration.

The site soils are anticipated to have a relatively low initial moisture content and be generally sandy. The field capacity of sand varies from approximately 5-8%; therefore, the addition of 1% water is expected to be held in capillary tension and not drain down to a significant depth below the test cells. After the moisture is added, the test cells will be allowed to acclimate for a period of 4 weeks before the "moist" respiration tests are conducted in the same manner as described in Section 4.1 above.

5. DESIGN PARAMETER COLLECTION

5.1 FIELD PARAMETERS

Field measurements are made using hand-held portable meters as detailed in Table 3. The meters are inserted into ports installed into a 2-foot-long × 4-inch diameter clear polyvinyl chloride (PVC) cell. The PVC cell will be utilized to allow the use of multiple probes at a single time. The relative humidity probe shall be placed at the cell entrance, within the vapor stream to induce turbulence and promote mixing of the vapors within the cell. Measurements are taken during purging. Purging is performed with a high vacuum, low flow Gast diaphragm pump rated at 1.0-1.7 cubic feet per minute. Wells are purged until oxygen stabilizes; however, no less than three casing volumes plus the volume of any sampling tubing are removed before recording final field meter measurements. Stabilization is defined as less than a 10% change between three consecutive readings. Data to be collected and the sampling frequencies for field measured

parameters are provided in Table 3. Data are recorded on the field forms provided in Attachment B. Manufacturer's specifications for field equipment are provided in Attachment C.

5.2 SOIL VAPOR SAMPLING AND ANALYSIS

Samples for laboratory analyses are collected in accordance with Table 4. At least three casing volumes are purged from the vapor wells before sample collection. Table 4 provides a summary of analytical parameters, test methods, number of samples, data use, and frequency of testing. Sample collection methodology and quality control generally follow the requirements in the Work Plan for SVM and Drinking Water Monitoring, Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-111 (USACE, 2018).

Analytical testing for vapor samples collected in support of the bioventing pilot test are performed by EAT. EAT maintains current Department of Defense Environmental Laboratory Accreditation Program certification for U.S. Environmental Protection Agency (EPA) Method TO-15 selective ion monitoring for volatile organic compounds; benzene, toluene, ethylbenzene, and xylenes and total petroleum hydrocarbons–gasoline range organics analyzed in accordance with EPA Method TO-3; and fixed gases (nitrogen, oxygen, hydrogen, carbon monoxide, and carbon dioxide) and C1 to C5 hydrocarbons in accordance with ASTM International Method D1945.

6. REFERENCES

U.S. Army Corps of Engineers. 2017. *Work Plan for Bioventing and Air-Lift Enhanced Bioremediation Pilot Tests, BFF, SWMU ST-106/SS-111.* Prepared by EA Engineering, Science, and Technology, Inc., PBC for the USACE–Albuquerque District under USACE Contract Number W9128F-13-D-0006. November.

U.S. Army Corps of Engineers. 2018. *Work Plan for Vadose Zone Coring, Vapor Monitoring, and Water Supply Sampling Bulk Fuels Facility, Solid Waste Management Unit (SWMU) ST-106/SS-111, Kirtland Air Force Base, New Mexico, Revision R2.* Prepared by EA Engineering, Science, and Technology, Inc., PBC for the USACE–Albuquerque District under USACE Contract Number W912DR-12-D-0006. March.

TABLES

Table 1
Bioventing Respiration Pilot Test Well Details and Function

Well ID	Screened Interval (ft bgs)	Diameter (in.)	Status	Well Use	Applicable Tests[1]	Attendant Observation Wells[2]	Radial Distance to Associated Injection Well (ft)
SVMW-11-100	100-102.5	0.5	Existing	Air Injection	"Dry" Respiration	KAFB-106V1-100	27
					"Moist" Respiration	KAFB-106V2-100	65
					Long-Term Biovent		
SVMW-11-250	250-252.5	0.5	Existing	Air Injection	"Dry" Respiration	KAFB-106V1-250	27
					"Moist" Respiration	KAFB-106V2-250	65
					Long-Term Biovent		
SVMW-11-260	260-262.5	0.5	Existing	Air Injection	"Dry" Respiration	KAFB-106V1-250	27
					"Moist" Respiration	KAFB-106V2-250	65
					Long-Term Biovent		
SVEW-01-260	245-260	4	Existing	Air Injection	"Dry" Respiration	KAFB-106V2-250	19
					"Moist" Respiration	KAFB-106V1-250	28
					Long-Term Biovent		
SVMW-10-100	100-102.5	0.5	Existing	Air Injection	"Dry" Respiration	KAFB-106V1-100	49
					"Moist" Respiration	SVMW-09-100	50
					Long-Term Biovent	KAFB-106V2-100	64
SVMW-10-150	150-152.5	0.5	Existing	Air Injection	"Dry" Respiration	KAFB-106V1-158	49
					"Moist" Respiration	KAFB-106V2-158	64
					Long-Term Biovent		
SVMW-10-250	250-252.5	0.5	Existing	Air Injection	"Dry" Respiration	KAFB-106V1-250	49
					"Moist" Respiration	SVMW-09-250	50
					Long-Term Biovent	KAFB-106V2-250	64
SVEW-02/03-160	145-160	2	Existing	Air Injection	"Dry" Respiration	KAFB-106V2-158	10
					"Moist" Respiration	KAFB-106V1-158	35
					Long-Term Biovent		
SVEW-04/05-313	298-313	2	Existing	Air Injection	"Dry" Respiration	KAFB-106V1-270	25
					"Moist" Respiration	KAFB-106V2-270	28
					Long-Term Biovent		
KAFB-106V1	100-102.5	0.75	Planned	Observation	Long-Term Biovent	N/A	28
	115-117.5	0.75				N/A	25
	157.5-160	0.75				N/A	35
	215-217.5	0.75				N/A	49
	250-252.5	0.75				N/A	27
	270-272.5	0.75				N/A	NA
KAFB-106V2	100-102.5	0.75	Planned	Observation	Long-Term Biovent	N/A	19
	115-117.5	0.75				N/A	28
	157.5-160	0.75				N/A	10
	215-217.5	0.75				N/A	64
	250-252.5	0.75				N/A	65
	270-272.5	0.75				N/A	NA

Notes:

1 Three types of treatabiity tests will be conducted: (1) single well "push-pull" respiration ***without*** moisture addition, (2) single well "push-pull" respiration ***with*** moisture addition, and long-term bioventing with multiple injection points operating in concert.

2. Observation wells will be used during respiration tests for pressure measurements and physical radius of influence only. During long-term bioventing test, observation wells will be used for respiration measurements as well.

Table 2
Bioventing Respiration Pilot Test Injection Design

Injection Well	Screened Interval (ft bgs)	Screen Length (ft)	Screen Diameter (in.)	Casing Volume (ft^3)	Filter Pack Thickness (ft)	Assumed Venting Thickness (ft)[1]	Test Cell Pore Volume (ft^3)[2]	Added Moisture Volume (gallons)[3]	Air Injection Period (days)	Design Flow Rate (cfm)	Nominal Pipe Velocity (ft/min)
SVMW-11-100	100-102.5	2.5	0.5	0.140	8.2	18.2	4500	337	3	4.2	3058
SVMW-11-250	250-252.5	2.5	0.5	0.344	7.3	17.3	4278	320	3	4.0	2906
SVMW-11-260	260-262.5	2.5	0.5	0.358	22.5	32.5	8036	601	3	7.4	5460
SVEW-01-260	245-260	15	4	22.678	26	36	8902	666	3	8.2	95
SVMW-10-100	100-102.5	2.5	0.5	0.140	7.9	17.9	4426	331	3	4.1	3007
SVMW-10-150	150-152.5	2.5	0.5	0.208	9.5	19.5	4822	361	3	4.5	3276
SVMW-10-250	250-252.5	2.5	0.5	0.344	10.3	20.3	5020	375	3	4.6	3410
SVEW-02/03-160	145-160	15	2	3.489	29	39	9644	721	3	8.9	410
SVEW-04/05-313	298-313	15	2	6.825	25	35	8655	647	3	8.0	368

[1] Vertical leakance into formation assumed 5 feet above and 5 below filter pack interval

[2] Test cell design radius = 15 feet

[3] Moisture added at 1 % of pore volume

Assumed porosity = 35%

cfm = Cubic feet per minute

ft = Feet

ft^3 = Cubic feet

ft bgs = Feet below ground surface

ft/min = Feet per minute

Table 3
Bioventing Respiration Pilot Testing Field Measurement Equipment and Regimen

Parameter	Field Measurement	Media	Instrument[a]	Range/ Tolerance	Data Use	Respiration Test Frequency[b]
Water Activity	Relative Humidity	Soil gas	Amprobe TH-3	0-100 % ± 3% R.H. at 23°C*	Determine relative humidity	Daily for first 3 days; days 5 and 7; biweekly thereafter
Pressure/ Vacuum	Injection/ Extraction Pressure Distribution	Vadose zone	Dwyer 477-A7	0.05 inches water column	Evaluate pressure	Daily for first 3 days; days 5 and 7; biweekly thereafter
Carbon Dioxide	Concentration in percent	Soil gas	Horiba	0-30% ± 0.3% by volume	Evaluate contaminant destruction rate	Daily for first 3 days; days 5 and 7; biweekly thereafter
Oxygen	Concentration in percent	Soil gas	Horiba	0-30% ± 0.1% by volume	Evaluate contaminant destruction rate	Daily for first 3 days; days 5 and 7; biweekly thereafter
Total Petroleum Hydrocarbons	Concentration in parts per million	Soil gas	Horiba	0-10,000 ppmv ± 10 ppmv	Evaluate soil vapor hydrocarbons	Daily for first 3 days; days 5 and 7; biweekly thereafter
Methane	Concentration in parts per million	Soil gas	Sensit PMD	0-5000 ppmv ± 10%	Evaluate contaminant destruction rate	Daily for first 3 days; days 5 and 7; biweekly thereafter
Flow Rate	Rotameter	Soil gas	Brooks 2520A4A37BNBN	0.3-3 scfm	Verify injection/purge rates	Daily for first 3 days; days 5 and 7; biweekly thereafter
Temperature	Temperature	Soil gas	Amprobe TH-3	-20-60°C ± 0.8°C	Evaluate temperature	Daily for first 3 days; days 5 and 7; biweekly thereafter

* This range and tolerance are based on instrument performance. Due to temperature variation and condensation, the actual field measurements will be less accurate. Test will be terminated when oxygen percent measurements have five linear points and/or oxygen is less than 5 percent.

[a] Or engineer approved equivalent

[b] Schedule can be adjusted based on observed oxygen utilization rates; goal is 5-10 data points in early linear portion of oxygen decay curve

° C = Degrees Celsius

ppmv = Parts per million (by volume)

Table 4
Bioventing Respiration Pilot Test Analytical Requirements and Frequency

Parameter	Method	Media	No. of Samples Per Event[a]	Sample Container	Data Use	Respiration Test Frequency
BTEX/TPH-GRO	EPA TO-3	Soil Vapor	12	1-liter Summa canister	Evaluate soil vapor hydrocarbons	Baseline and end of test
VOCs	EPA TO-15 SIM	Soil Vapor	12	1-liter Summa canister	Evaluate soil vapor EDB concentrations	Baseline and end of test
Fixed Gases[b]	ASTM D1945	Soil Vapor	12	1-liter Summa canister	Verify field instrument reading	Baseline and end of test
C1-C5 Hydrocarbon Compounds[c]	ASTM D1945	Soil Vapor	12	1-liter Summa canister	Evaluate degradation of EDB	Baseline and end of test

[a] Soil vapor samples collected from each of the six nested wells in both KAFB-106V1 and KAFB-106V2 (does not include quality control samples)

[b] Fixed gases: nitrogen, oxygen, hydrogen, carbon monoxide, and carbon dioxide

[c] C1-C5 hydrocarbon compounds: methane, ethane, propane, butane, and pentane

ASTM = ASTM International

BTEX = Benzene, toluene, ethylbenzene, and xylenes

EDB = Ethylene dibromide (1,2-dibromoethane)

EPA = U.S. Environmental Protection Agency

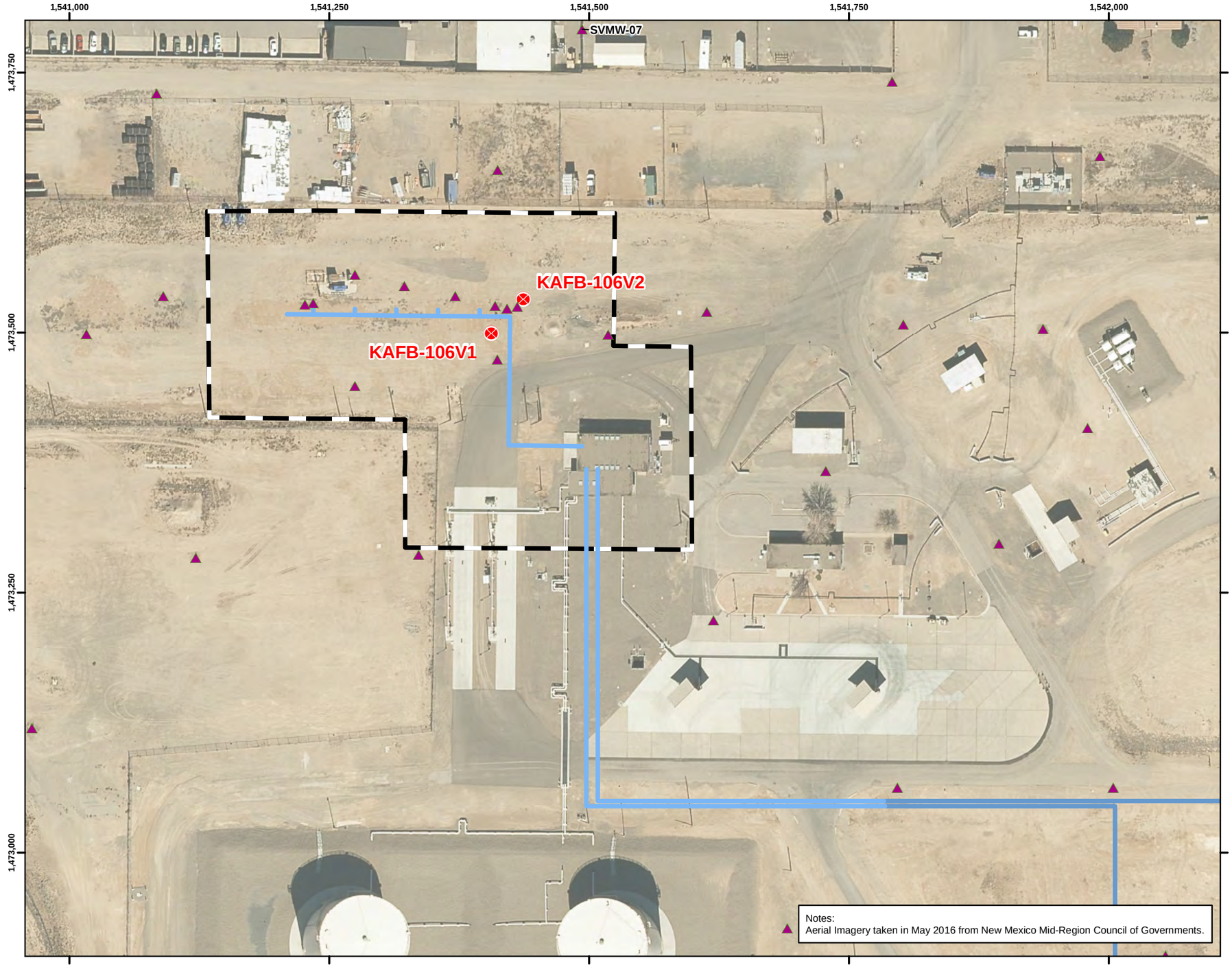
GRO = Gasoline range organics

SIM = Selective ion monitoring

TPH = Total petroleum hydrocarbons

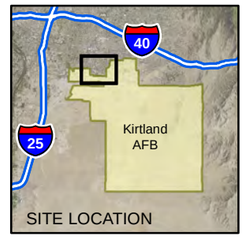
VOC = Volatile organic compound

FIGURES



Legend

- Existing Soil Vapor Well
- Proposed Biovent Observation Well
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Bulk Fuels Facility (SWMU ST-106/SS-111)



N

0 50 100 200

Feet

1 inch = 100 feet

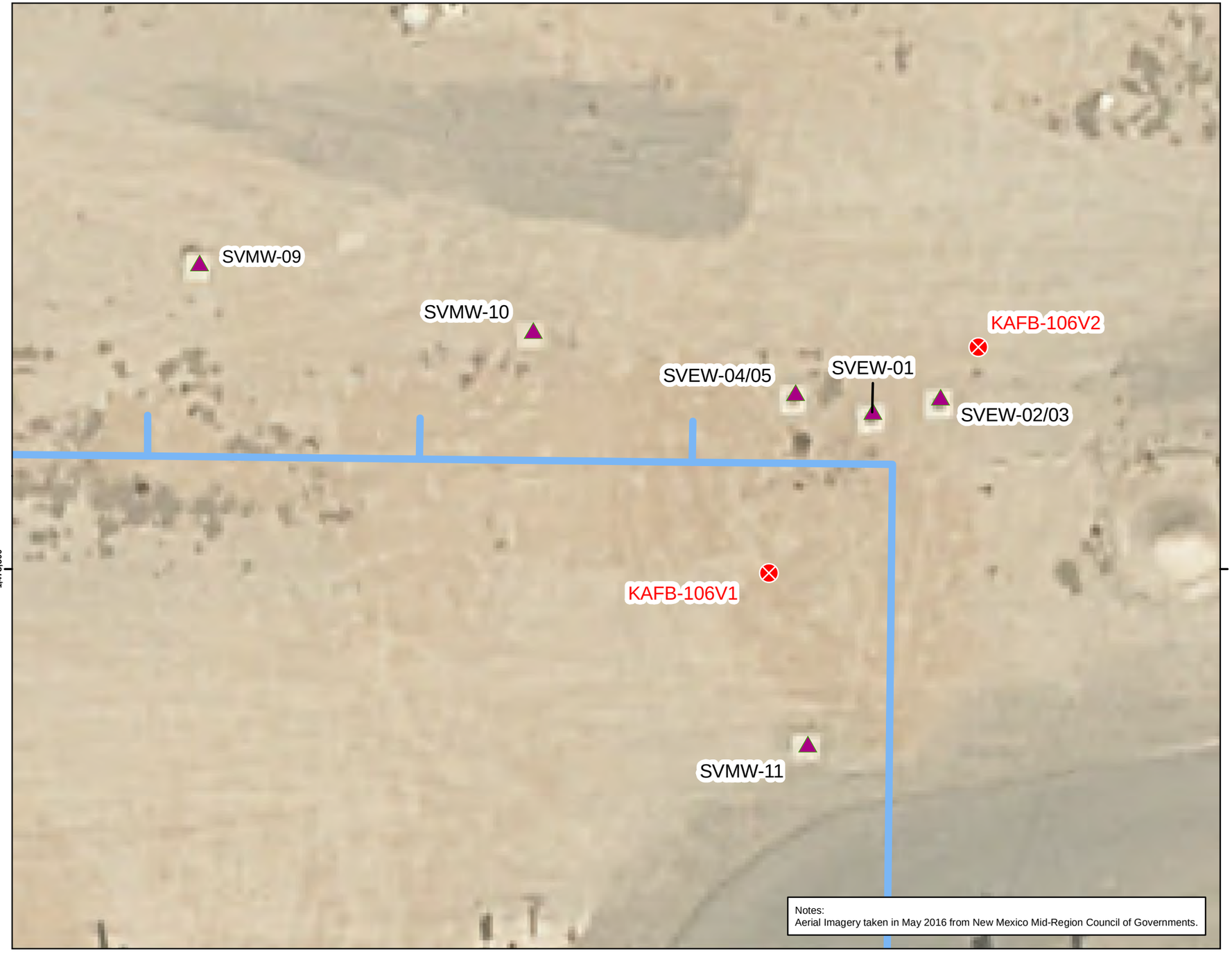
Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

BIOVENTING RESPIRATION PILOT TESTING PROCEDURE
BULK FUELS FACILITY
SOLID WASTE MANAGEMENT UNIT ST-106/SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 1

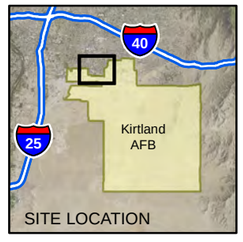
PILOT TESTING AREAS

P:\gis\Projects\Kirtland\Figures\Vadose Zone Work Plan\VZ_WP_Bioventing\Figure 1 Pilot Testing Area.mxd 6/19/2018 EA eomalia



Legend

- Existing Soil Vapor Well
- Proposed Biovent Observation Well
- Former Buried Fuel Transfer Line
- Installation Boundary
- Source Area



N

0 7.5 15 30

Feet

1 inch = 15 feet

Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

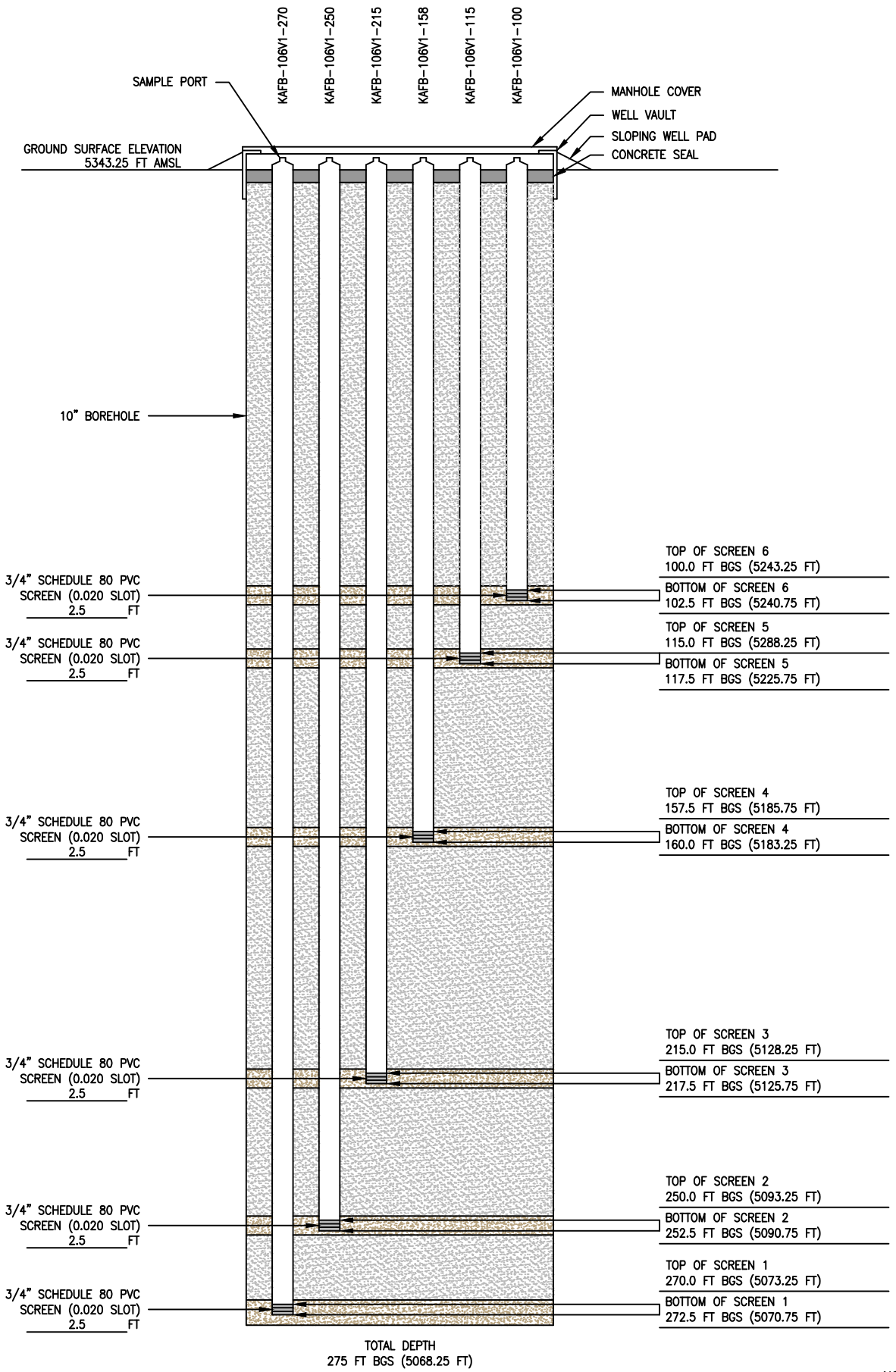
BIOVENTING RESPIRATION PILOT TESTING PROCEDURE
BULK FUELS FACILITY
SOLID WASTE MANAGEMENT UNIT ST-106/SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 2

LOCATIONS OF BIOVENTING PILOT TEST WELLS

P:\gis\Projects\Kirtland\Figures\Vadose Zone Work Plan\VZ_WP_Bioventing\Figure 2 Locations of Bioventing Pilot Test Wells.mxd 6/19/2018 EA eomalia

FIGURE 3: NESTED SOIL VAPOR WELL COMPLETION DIAGRAM FOR KAFB-106V1



(ELEVATION) IS IN ABOVE MEAN SEA LEVEL
ASML □ ABOVE MEAN SEA LEVEL

NOT TO SCALE
BGS □ BELOW GROUND SURFACE
FT □ FEET

FIGURE 3: NESTED SOIL VAPOR WELL COMPLETION DIAGRAM FOR KAFB-106V1

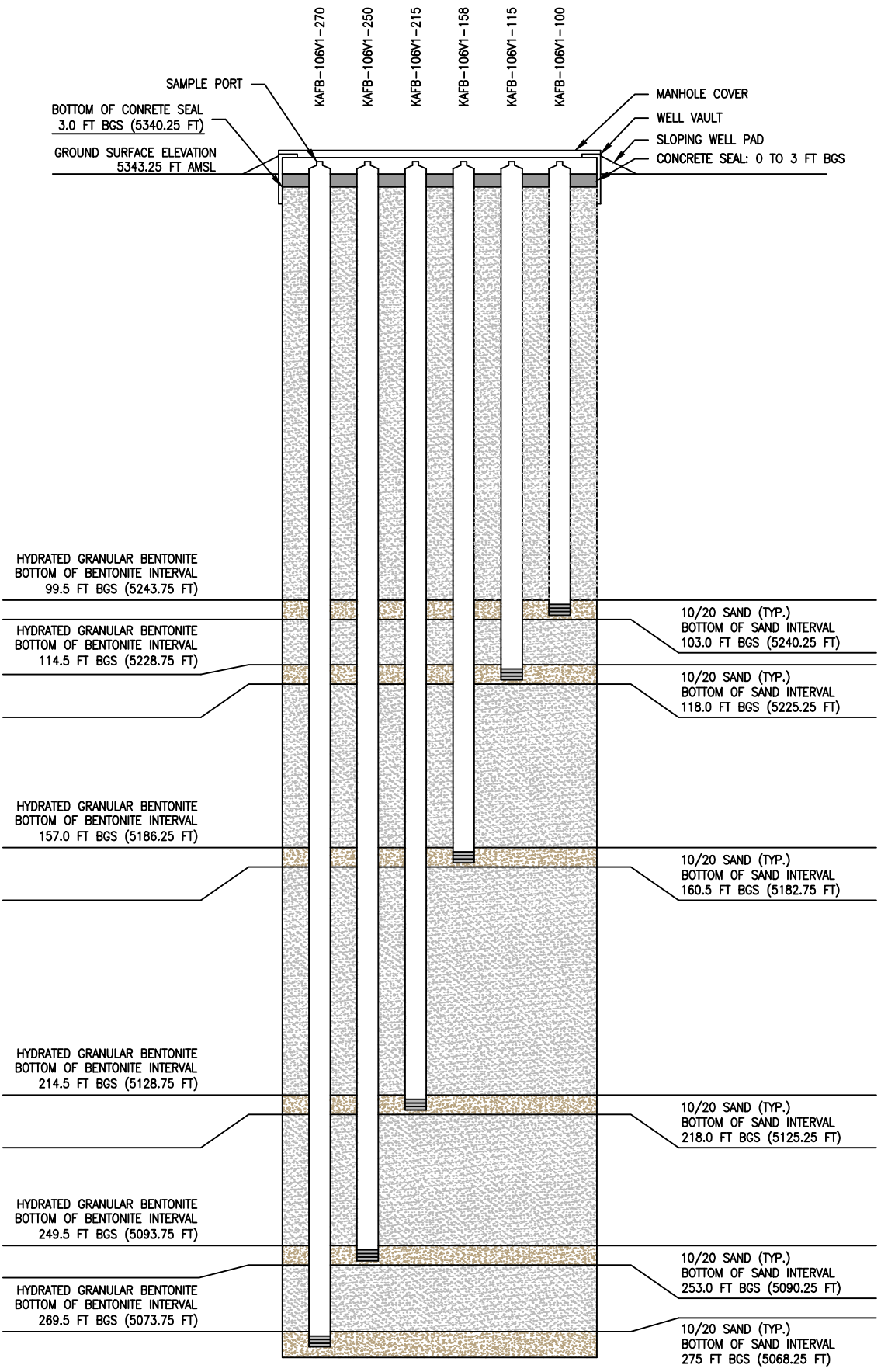


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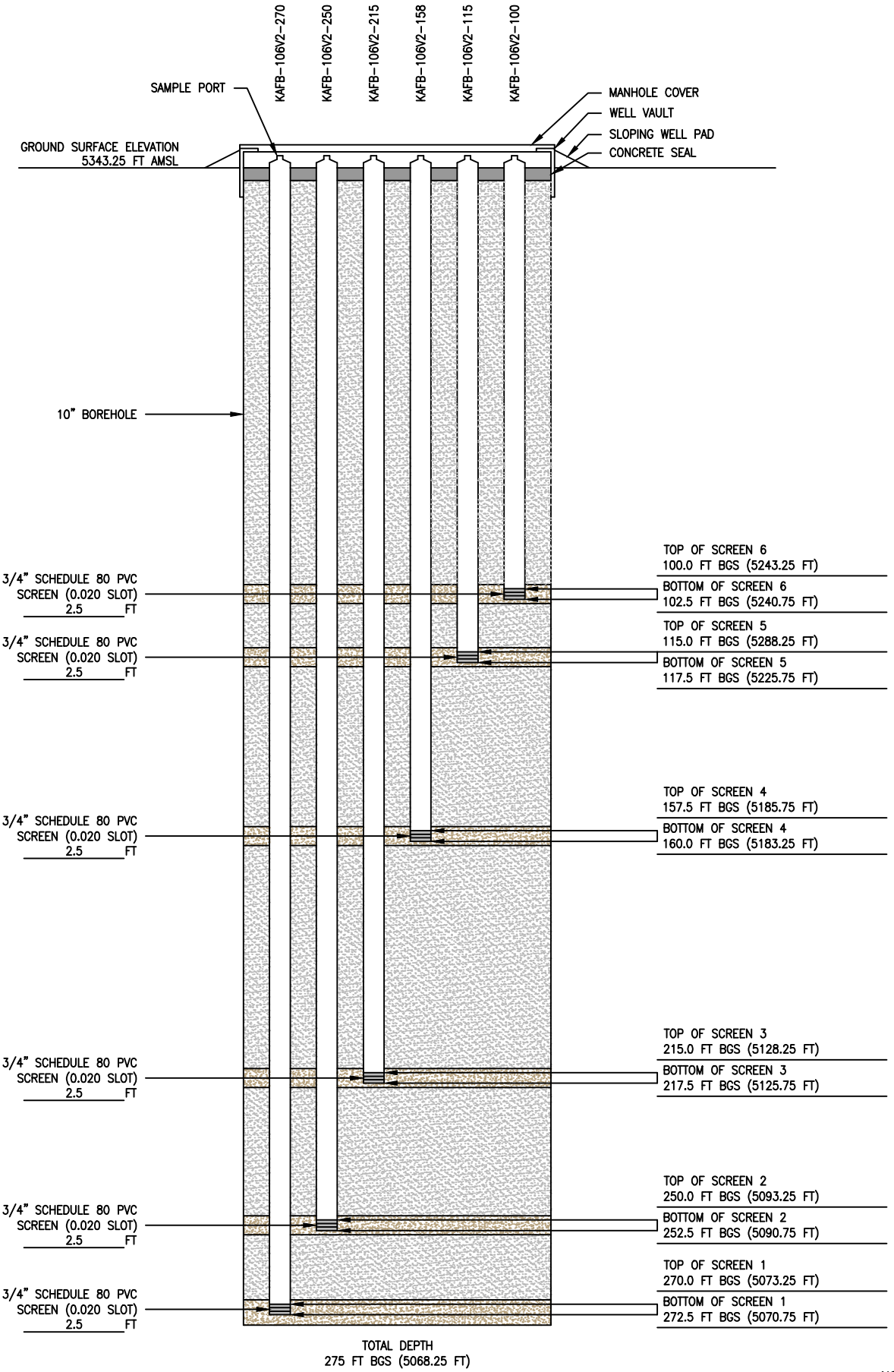
FIGURE 4: NESTED SOIL VAPOR WELL COMPLETION DIAGRAM FOR KAFB-106V2



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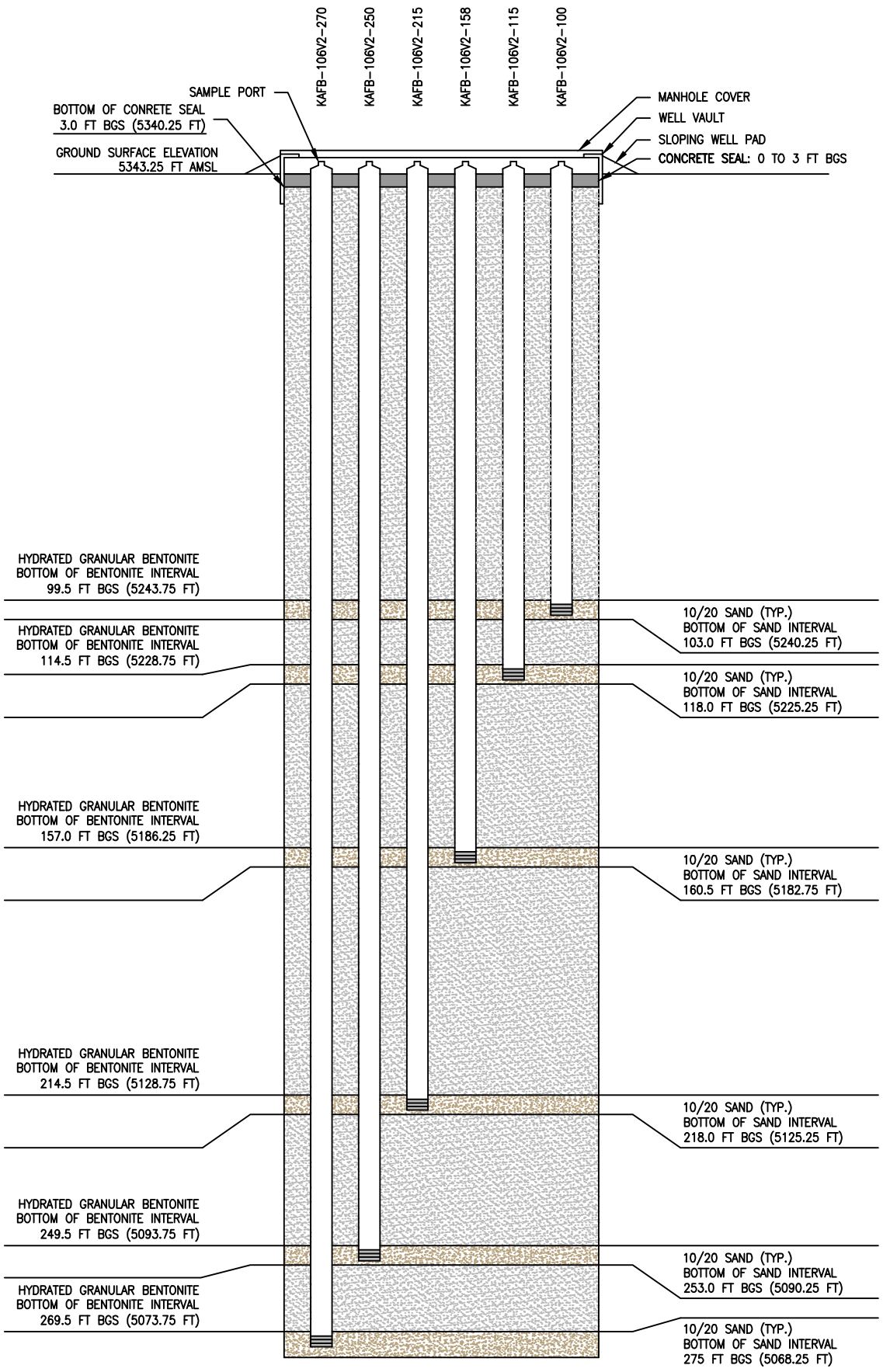
FT □ FEET

FIGURE 4: NESTED SOIL VAPOR WELL COMPLETION DIAGRAM FOR KAFB-106V2



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BGS □ BELOW GROUND SURFACE
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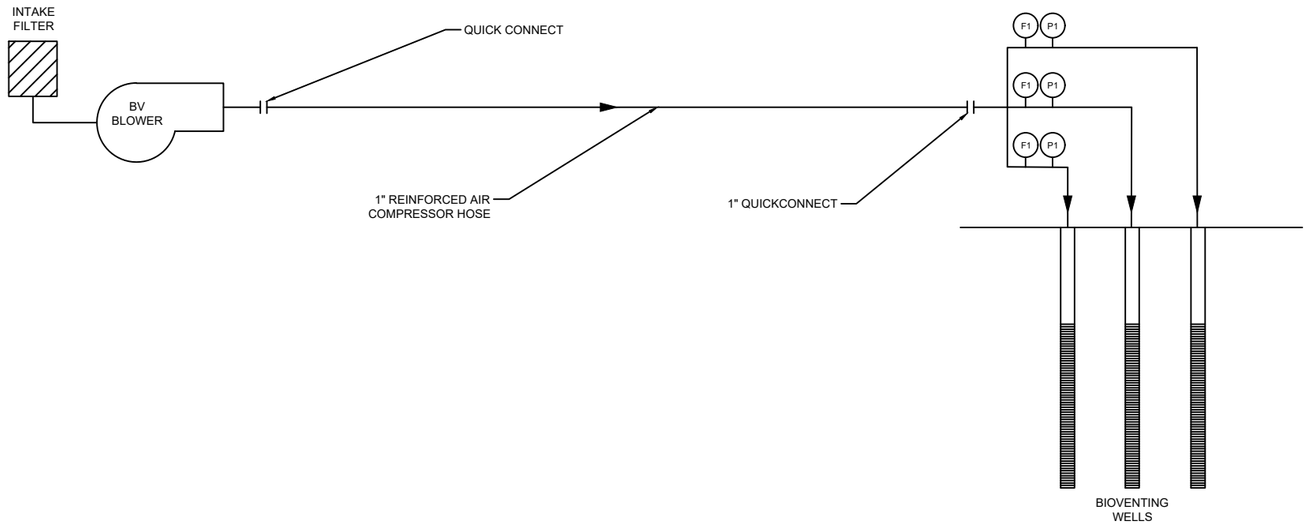
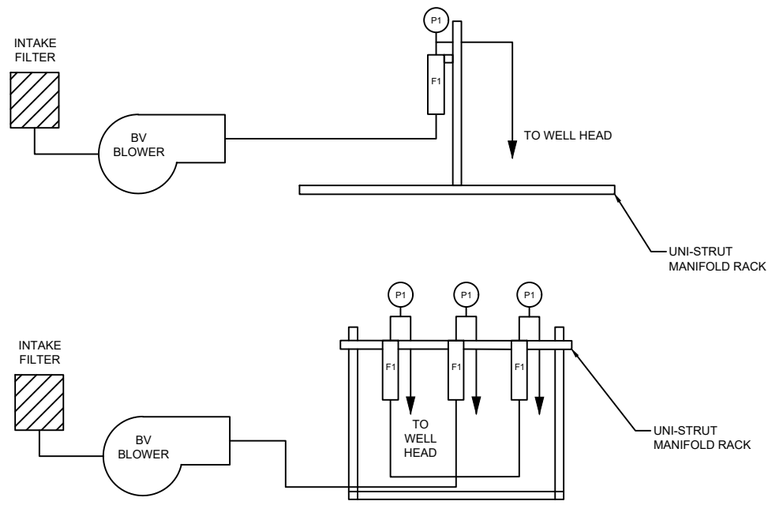
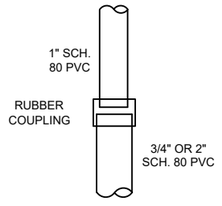




ELEVATION VIEW



WELL CONNECTION DETAIL

P1 : PRESSURE GAUGE, 0-25 PSI (GRAINGER MODEL: 4FLT8 OR APPROVED EQUIVALENT)
F1 : ROTAMETER, 1-10 SCFM (BROOKS MODEL: 2530A4A65SVVT OR APPROVED EQUIVALENT)
NOTE: ALL PIPE FITTING ARE SCH. 80 PVC UNLESS OTHERWISE STATED.
ROTAMETERS ARE EQUIPPED WITH A FLOW CONTROL VALVE.

BV BLOWER - BIOVENTING BLOWER
SCFM - STANDARD CUBIC FEET PER MINUTE
PSI - POUND PER SQUARE INCH
PVC - POLYVINYL CHLORIDE
SCH. - SCHEDULE

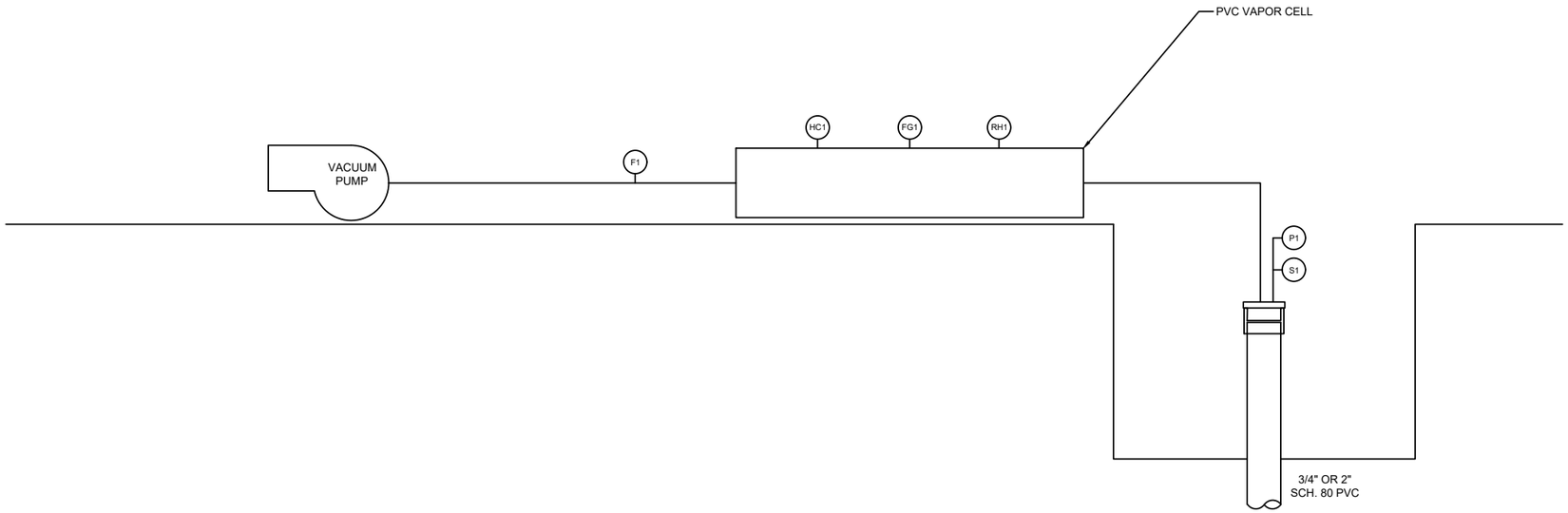
DRAWN BY: TC
DESIGNED BY: TC
PROJECT MANAGER: DJ
PROJECT NO: 62735DM02

KIRTLAND AIR FORCE BASE

FIGURE 5. BIOVENTING RESPIRATION PILOT TEST
AIR INJECTION PIPING AND INSTRUMENTATION DIAGRAM

320 Gold Avenue, SW Suite 1300
Albuquerque, NM 87102
Phone: (505) 224-9013
EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC

P:\Active Projects\62735DM02 Kirtland Vadose Zone\CLIN 1038 Bioventing Pilot Test



P1 : PRESSURE GAUGE, 0-200 IWC (DWYER 477 DIGITAL MANOMETER)
S1 : ANALYTICAL SAMPLE PORT
FG1 : FIXED GASES MONITORING PORT
RH1 : RELATIVE HUMIDITY AND TEMPERATURE MONITORING PORT
HC1 : TOTAL PETROLEUM HYDROCARBON MONITORING PORT
F1 : ROTAMETER, 0.3-3 SCFM (BROOKS MODEL: 2520A4A37BNBN OR APPROVED EQUIVALENT)
NOTE: VAPOR CELL SHALL BE CONSTRUCTED OF CLEAR, SCH 40 PVC
CONVEYANCE LINE SHALL CONSIST OF $\frac{1}{4}$" FEB TUBING
ROTAMETERS ARE EQUIPPED WITH A FLOW CONTROL VALVE.

SCFM - STANDARD CUBIC FEET PER MINUTE
IWC - INCHES OF WATER COLUMN
PVC - POLYVINYL CHLORIDE
SCH. - SCHEDULE

DRAWN BY: TC
DESIGNED BY: TC
PROJECT MANAGER: DJ
PROJECT NO: 62735DM02

KIRTLAND AIR FORCE BASE

FIGURE 6. BIOVENTING RESPIRATION PILOT TEST
VAPOR MONITORING PIPING AND INSTRUMENTATION DIAGRAM

320 Gold Avenue, SW Suite 1300
Albuquerque, NM 87102
Phone: (505) 224-9013
EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC

P:\Active Projects\62735DM02 Kirtland Vadose Zone\CLIN 1038 Bioventing Pilot Test

ATTACHMENTS

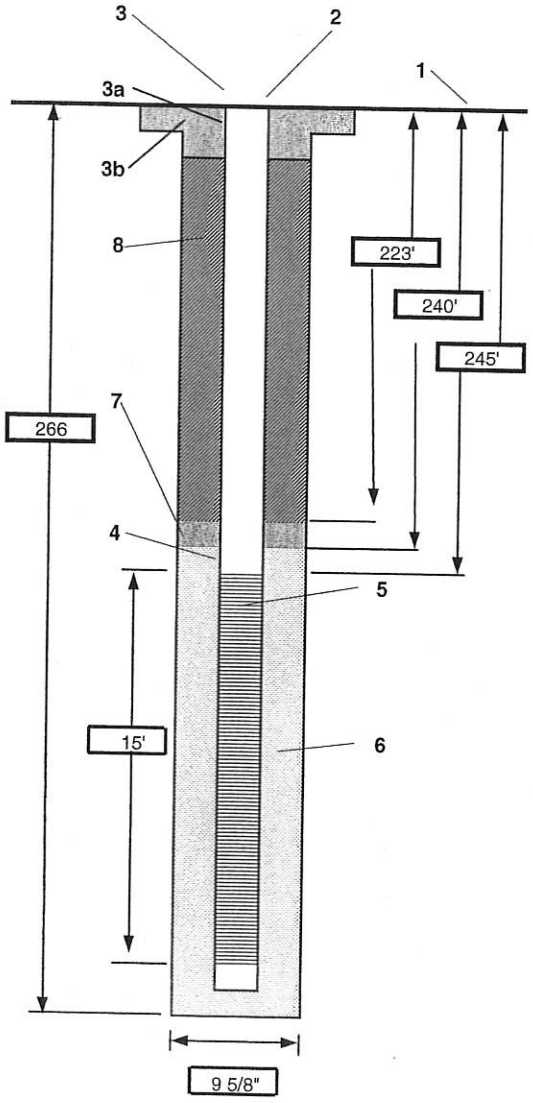
Attachment A – Well Construction Diagrams

CH2MHILL

PROJECT NUMBER	WELL NUMBER	
168206.02.TT.WI	SVEW-01	SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : KAFB Bulk Fuels Facility (ST-106) LOCATION : Bulk Fuels Facility - KAFB
DRILLING CONTRACTOR : Water Development Corp/Mark Green
DRILLING METHOD AND EQUIPMENT USED : Star 30K - Air Rotary - Casing Hammer
WATER LEVEL : NA START : 02/26/2003 END: 02/26/2003 LOGGER : D.BossWalker/ABQ



1- Ground elevation at well: Approximately 5339'

2- Top of casing elevation
a) vent hole? NA

3- Wellhead protection cover type: 12" Flush mount, locking caps
a) weep hole? NA
b) concrete pad dimensions: 4' square flush mount

4- Dia./type of well casing: 4" Stainless Steel

5- Type/slot size of screen: 4" Stainless Steel
0.050" slot

6- Type screen filter: 8x12 size sand, Colorado Silica Sand
28x50lb sacks

7- Type of seal: Enviroplug 3/8" Bentonite Chips
9x50lb sacks

8- Surface Seal
a) Grout mix used: Environplug Bentonite Slurry
b) Method of placement: Pump
c) Vol. of well casing grout

Development method: NA

Development time: NA

Estimated purge volume: NA

Comments: 5' sump below screen.

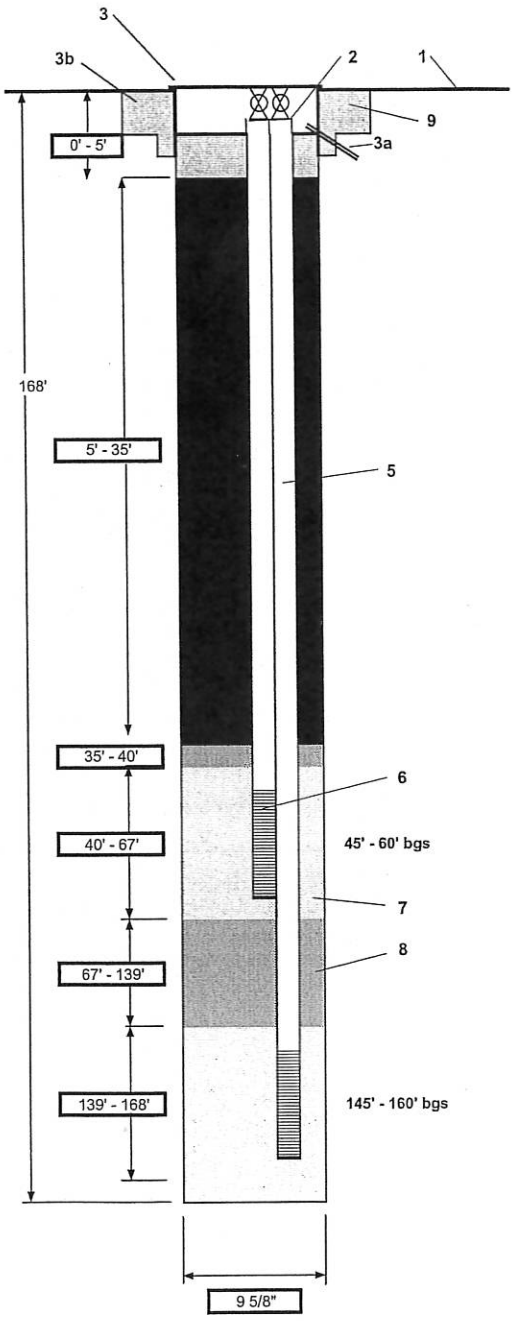
Illustration not to scale.

CH2MHILL

PROJECT NUMBER	WELL NUMBER		
179495.01.TT.WI	SVEW-02-03	SHEET 1	OF 1

SOIL VAPOR EXTRACTION WELL COMPLETION DIAGRAM

PROJECT : KAFB Bulk Fuels Facility (ST-106) LOCATION : Bulk Fuels Facility - KAFB
ELEVATION: NA DRILLING CONTRACTOR : Water Development Corporation- Mike Thomas
DRILLING METHOD AND EQUIPMENT USED: Star 30K - Air Rotary - Casing Hammer
WATER LEVELS : NA START : 9/10/2003 END : 9/16/2003 LOGGER : D.Boss-Walker



1- Ground elevation at well	approximately 5340'
2- Top of casing elevation	NA
3- Wellhead protection cover type	NA
a) drain tube?	None
b) concrete pad dimensions	NA
4- Dia./type surface casing	None
5- Dia./type of well casing	2" Nom. OD Stainless Steel - Nested pair
6- Type/slot/size of screen	2" Nom. OD Stainless Steel 0.050 slot, 15' long
7- Type screen filter	8 x 12 Oglebay Colorado Silica
quantity used	19 x 100 lb Sacks
8- Type of seal	Hydrated Enviroplug 3/8" (medium)
quantity used	Bentonite chips - 74 x 50 lb Sacks
9- Grout	
a) Grout mix used	Volclay Bentonite Grout - 43x50 lb Sacks
b) Method of placement	Grout Pump
c) Vol.of surface casing grout	NA
d) Vol. of well casing grout	NA
Development method	NA
Development time	NA
Estimated purge volume	NA

Comments

SVEW-03 is the deeper well with a screened interval of 145' - 160'
SVEW-02 is the shallower well with a screened interval of 45' - 60'

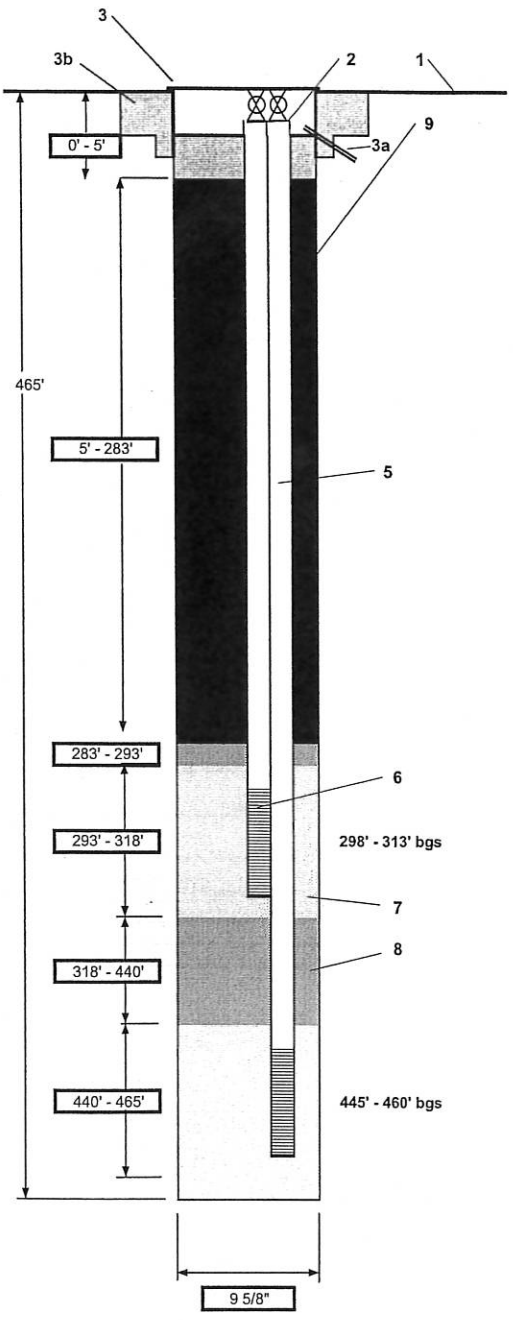
Illustration not to scale.

CH2MHILL

PROJECT NUMBER	WELL NUMBER	
179495.01.TT.WI	SVEW-04-05	SHEET 1 OF 1

SOIL VAPOR EXTRACTION WELL COMPLETION DIAGRAM

PROJECT : KAFB Bulk Fuels Facility (ST-106)
LOCATION : Bulk Fuels Facility - KAFB
ELEVATION: NA
DRILLING CONTRACTOR : Water Development Corporation- Mike Thomas
DRILLING METHOD AND EQUIPMENT USED: Star 30K - Air Rotary - Casing Hammer
WATER LEVELS : NA
START : 9/22/2003 END : 9/24/2003 LOGGER : D.Boss-Walker



1- Ground elevation at well	approximately 5340'
2- Top of casing elevation	NA
3- Wellhead protection cover type	NA
a) drain tube?	None
b) concrete pad dimensions	NA
4- Dia./type surface casing	NA
5- Dia./type of well casing	2" Nom. OD Stainless Steel - Nested pair
6- Type/slot/size of screen	2" Nom. OD Stainless Steel 0.050 slot, 15' long
7- Type screen filter	8 x 12 Oglebay Colorado Silica
quantity used	34 x 100 lb Sacks
8- Type of seal	Hydrated Enviroplug 3/8" (medium)
quantity used	Bentonite chips - 99 x 50 lb Sacks
9- Grout	
a) Grout mix used	Volclay Bentonite Grout - 50x50 lb Sacks
b) Method of placement	Grout Pump
c) Vol.of surface casing grout	NA
d) Vol. of well casing grout	NA
Development method	NA
Development time	NA
Estimated purge volume	NA

Comments

SVEW-05 is the deeper well with a screened interval of 445' - 460'
SVEW-04 is the shallower well with a screened interval of 298' - 313'

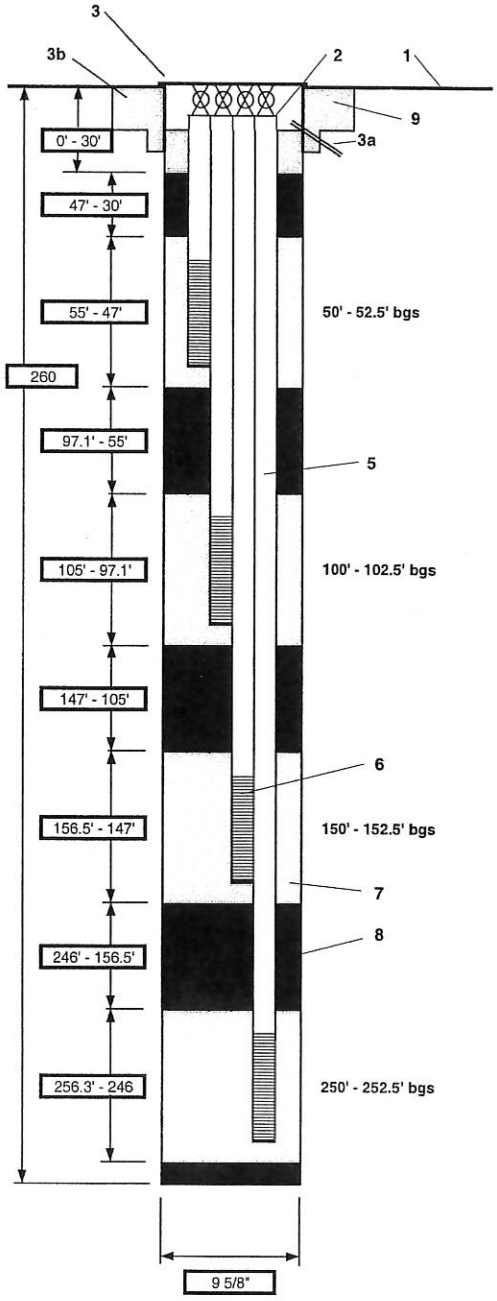
Illustration not to scale.

CH2MHILL

PROJECT NUMBER	WELL NUMBER		
168206.02.TT.WI	SVMW-10	SHEET 1	OF 1

SOIL VAPOR WELL COMPLETION DIAGRAM

PROJECT : KAFB Bulk Fuels Facility (ST-106) LOCATION : Bulk Fuels Facility - KAFB
ELEVATION: 5340.84' DRILLING CONTRACTOR : Water Development Corporation / Mark Green
DRILLING METHOD AND EQUIPMENT USED: SpeedStar 30K Stratex ARCH w/18" split spoon
WATER LEVELS : NA START : 02/20/2003 END : 02/21/2003 LOGGER : D.Boss-Walker



1- Ground elevation at well	approximately 5339'
2- Top of casing elevation	NA
3- Wellhead protection cover type	12" flush mount, locking caps
a) drain tube?	None
b) concrete pad dimensions	4' square flush mount
4- Dia./type surface casing	None
5- Dia./type of well casing	1/2" Nom. OD Schedule 80 PVC w/ball valve
6- Type/slot/size of screen	1/2" Nom. OD Schedule 80 PVC 0.050 slot, 2 1/2' long
7- Type screen filter	8 - 12 Oglebay Colorado Silica
quantity used	50 x 50 lb sacks
8- Type of seal	Hydrated Enviroplug 3/8" (medium)
quantity used	Bentonite chips - 119 x 50 lb sacks
9- Grout	
a) Grout mix used	Potland Cement
b) Method of placement	Pump
c) Vol.of surface casing grout	
d) Vol. of well casing grout	
Development method	NA
Development time	NA
Estimated purge volume	NA

Comments
Each of the four 1/2" wells is labelled with a small metal plate attached with a hoseclamp by a small metal chain

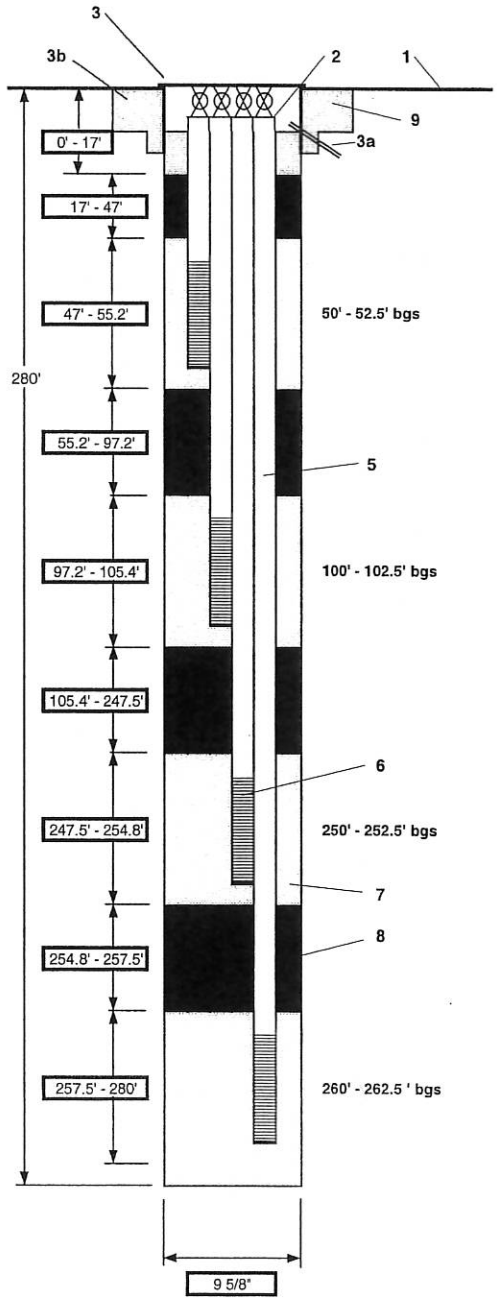
Illustration not to scale.

CH2MHILL

PROJECT NUMBER	WELL NUMBER	
168206.02.TT.WI	SVMW-11	SHEET 1 OF 1

SOIL VAPOR WELL COMPLETION DIAGRAM

PROJECT : KAFB Bulk Fuels Facility (ST-106) LOCATION : Bulk Fuels Facility - KAFB
ELEVATION: 5340.64' DRILLING CONTRACTOR : Water Development Corporation / Mark Green
DRILLING METHOD AND EQUIPMENT USED: SpeedStar 30K Stratex ARCH w/18" split spoon
WATER LEVELS : NA START : 02/23/2003 END : 02/24/2003 LOGGER : D.Boss-Walker



1- Ground elevation at well	approximately 5339'
2- Top of casing elevation	NA
3- Wellhead protection cover type	12" flush mount, locking caps
a) drain tube?	None
b) concrete pad dimensions	4' square flush mount
4- Dia./type surface casing	None
5- Dia./type of well casing	1/2" Nom. OD Schedule 80 PVC w/ball valve
6- Type/slot/size of screen	1/2" Nom. OD Schedule 80 PVC 0.050 slot, 2 1/2' long
7- Type screen filter	8 - 12 Oglebay Colorado Silica
quantity used	52 x 50 lb sacks
8- Type of seal	Hydrated Enviroplug 3/8" (medium)
quantity used	Bentonite chips - 163 x 50 lb sacks
9- Grout	
a) Grout mix used	Potland Cement
b) Method of placement	Pump
c) Vol.of surface casing grout	
d) Vol. of well casing grout	
Development method	NA
Development time	NA
Estimated purge volume	NA

Comments
Each of the four 1/2" wells is labelled with a small metal plate attached with a hoseclamp by a small metal chain

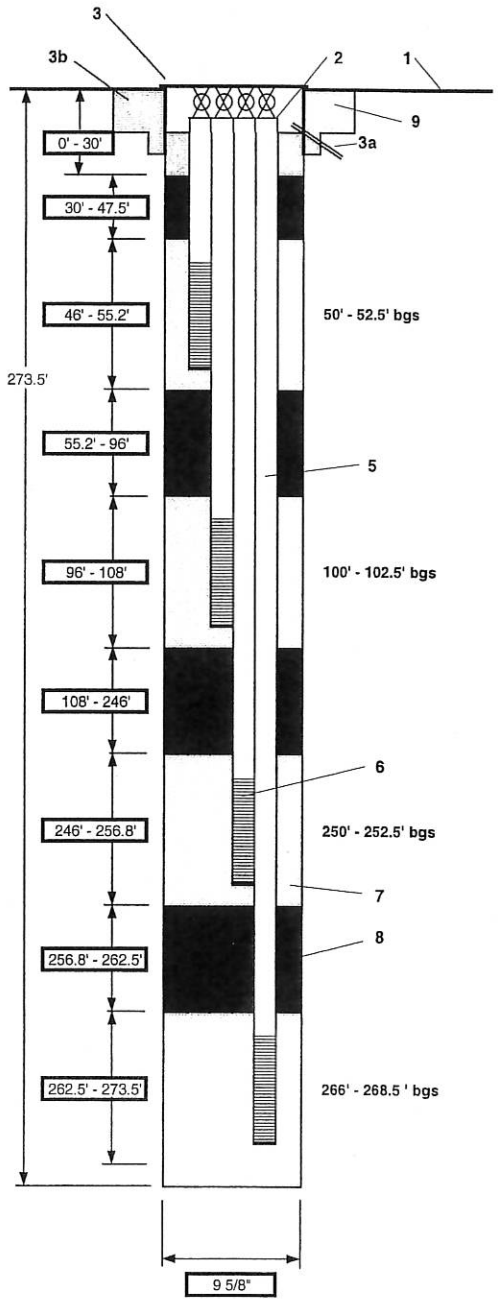
Illustration not to scale.

CH2MHILL

PROJECT NUMBER	WELL NUMBER		
168206.02.TT.WI	SVMW-09	SHEET 1	OF 1

SOIL VAPOR WELL COMPLETION DIAGRAM

PROJECT : KAFB Bulk Fuels Facility (ST-106) LOCATION : Bulk Fuels Facility - KAFB
ELEVATION: 5340.75' DRILLING CONTRACTOR : Water Development Corporation / Mark Green
DRILLING METHOD AND EQUIPMENT USED: SpeedStar 30K Stratex ARCH w/18" split spoon
WATER LEVELS : NA START : 02/06/2003 END : 02/08/2003 LOGGER : D.Boss-Walker



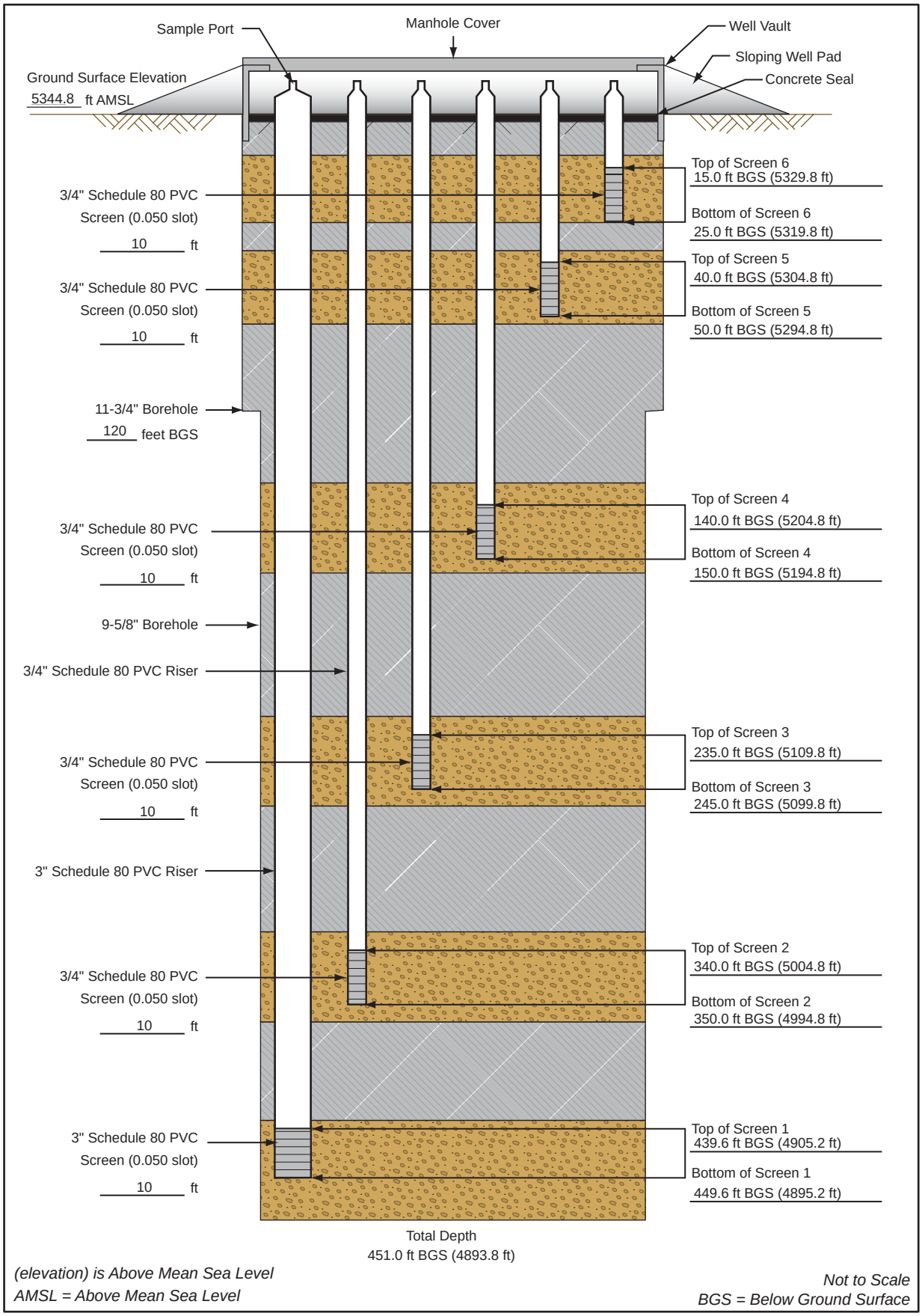
1- Ground elevation at well	approximately 5339'
2- Top of casing elevation	NA
3- Wellhead protection cover type	12" flush mount, locking caps
a) drain tube?	None
b) concrete pad dimensions	4' square flush mount
4- Dia./type surface casing	None
5- Dia./type of well casing	1/2" Nom. OD Schedule 80 PVC w/ball valve
6- Type/slot/size of screen	1/2" Nom. OD Schedule 80 PVC 0.050 slot, 2 1/2' long
7- Type screen filter	8 - 12 Oglebay Colorado Silica
quantity used	56 x 50 lb sacks
8- Type of seal	Hydrated Enviroplug 3/8" (medium)
quantity used	Bentonite chips - 201 x 50 lb sacks
9- Grout	
a) Grout mix used	Potland Cement
b) Method of placement	Pump
c) Vol.of surface casing grout	
d) Vol. of well casing grout	
Development method	NA
Development time	NA
Estimated purge volume	NA

Comments
Each of the four 1/2" wells is labelled with a small metal plate attached with a hoseclamp by a small metal chain

Illustration not to scale.

Nested Soil Vapor Well Completion Diagram for KAFB-106114

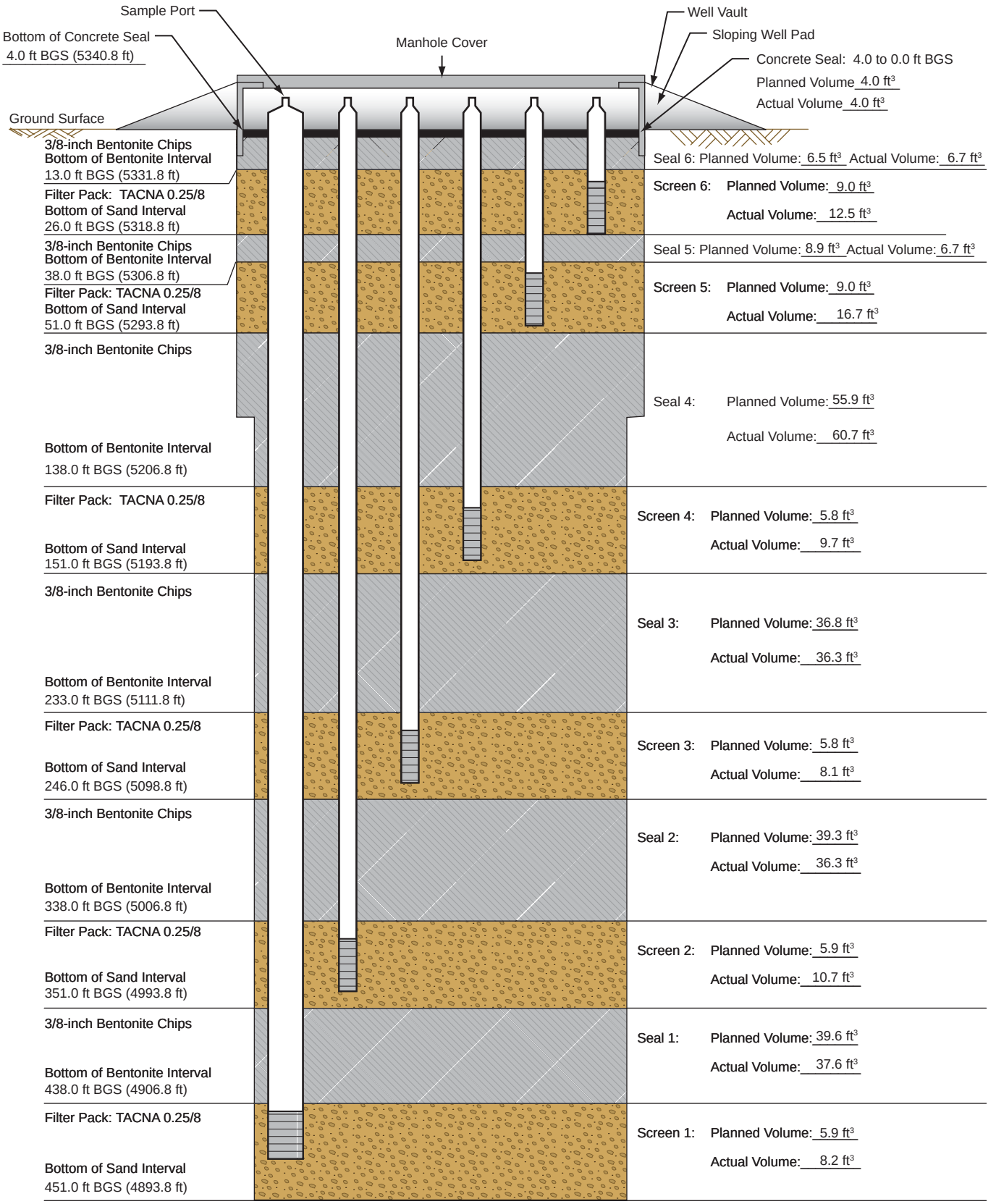
Installation Start Date/Time: 2/23/2011 @ 16:10
Installation End Date/Time: 3/1/2011 @ 17:00



(elevation) is Above Mean Sea Level
AMSL = Above Mean Sea Level

Not to Scale
BGS = Below Ground Surface

Nested Soil Vapor Well Completion Diagram for KAFB-106114



(elevation) is Above Mean Sea Level
All Materials Placed with Tremie Pipe

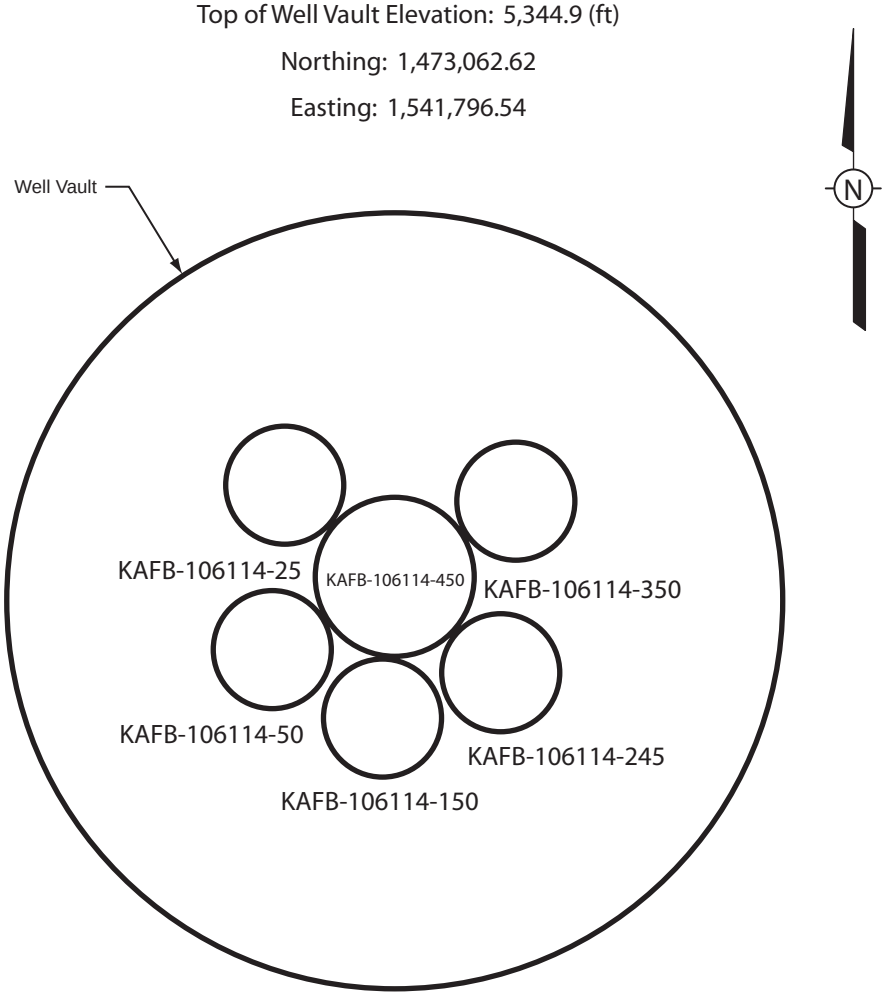
Not to Scale
BGS = Below Ground Surface

Nested Soil Vapor Well Completion Diagram
Map View for KAFB-106114

Top of Well Vault Elevation: 5,344.9 (ft)

Northing: 1,473,062.62

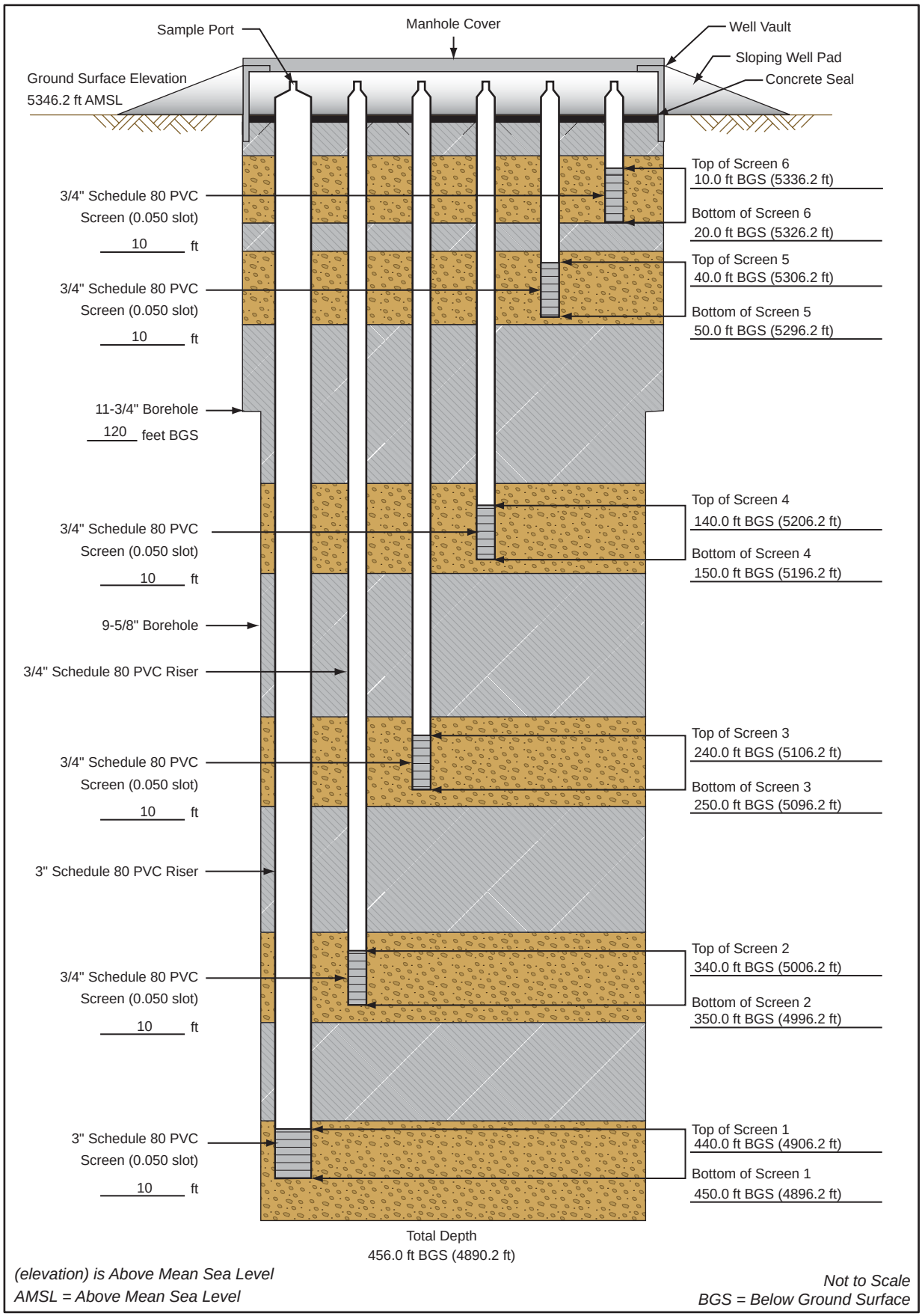
Easting: 1,541,796.54



Well Number	Well Diameter (in)	Well Depth (ft BGS)	Screened Interval (ft BGS)	Northing	Easting	Elevation (ft AMSL)
KAFB-106114-25	3/4	25.0	15.0 - 25.0	1,473,062.35	1,541,796.49	5344.6
KAFB-106114-50	3/4	50.0	40.0 - 50.0	1,473,062.13	1,541,796.24	5344.6
KAFB-106114-150	3/4	150.0	140.0 - 150.0	1,473,061.84	1,541,796.37	5344.6
KAFB-106114-245	3/4	245.0	235.0 - 245.0	1,473,061.86	1,541,796.68	5344.6
KAFB-106114-350	3/4	350.0	340.0 - 350.0	1,473,062.17	1,541,796.71	5344.6
KAFB-106114-450	3	449.6	439.6 - 449.6	1,473,062.21	1,541,796.50	5344.6

Nested Soil Vapor Well Completion Diagram for KAFB-106116

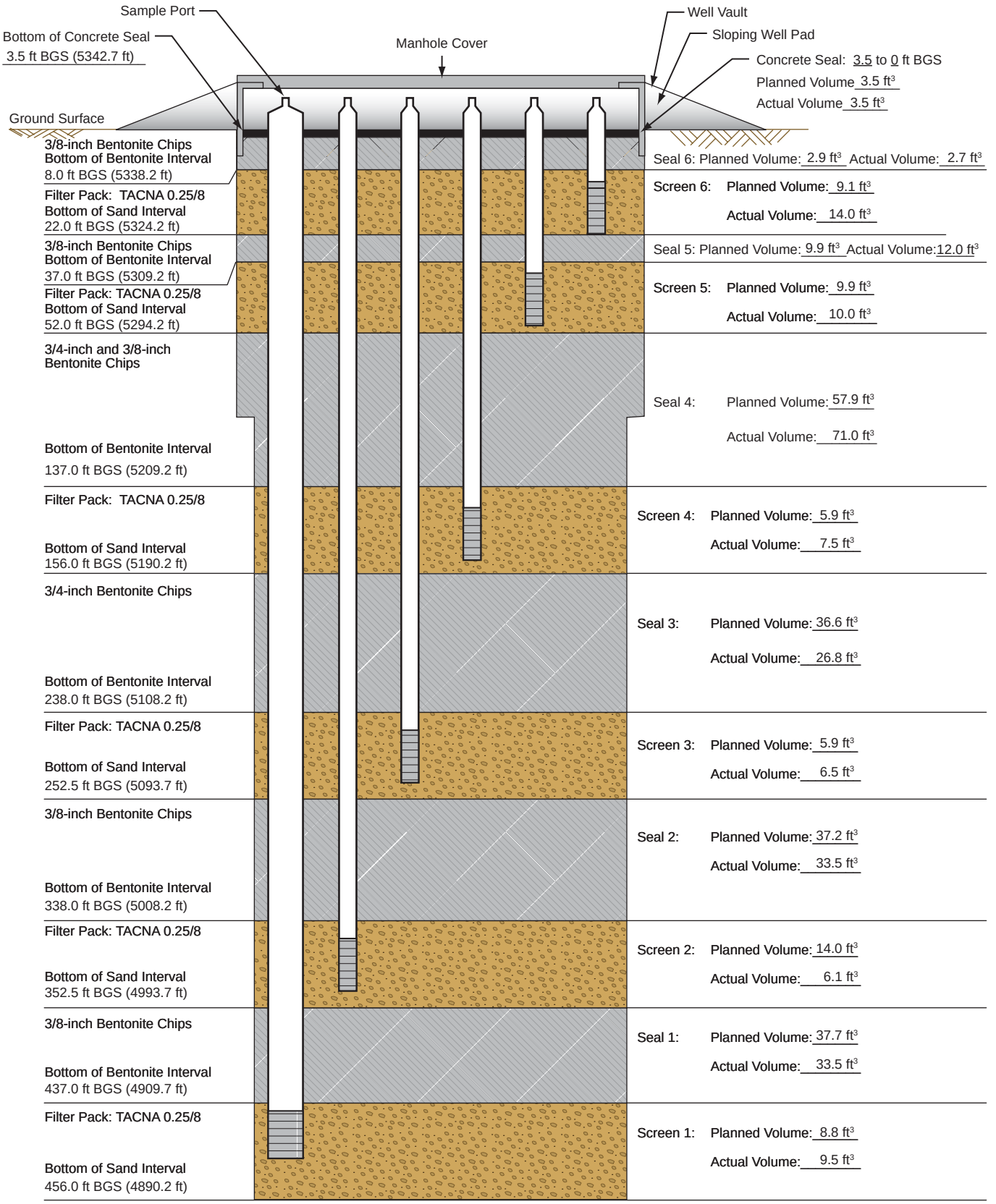
Installation Start Date/Time: 3/7/2011 @ 08:15
Installation End Date/Time: 3/10/2011 @ 12:32



(elevation) is Above Mean Sea Level
AMSL = Above Mean Sea Level

Not to Scale
BGS = Below Ground Surface

Nested Soil Vapor Well Completion Diagram for KAFB-106116



(elevation) is Above Mean Sea Level
All Materials Placed with Tremie Pipe

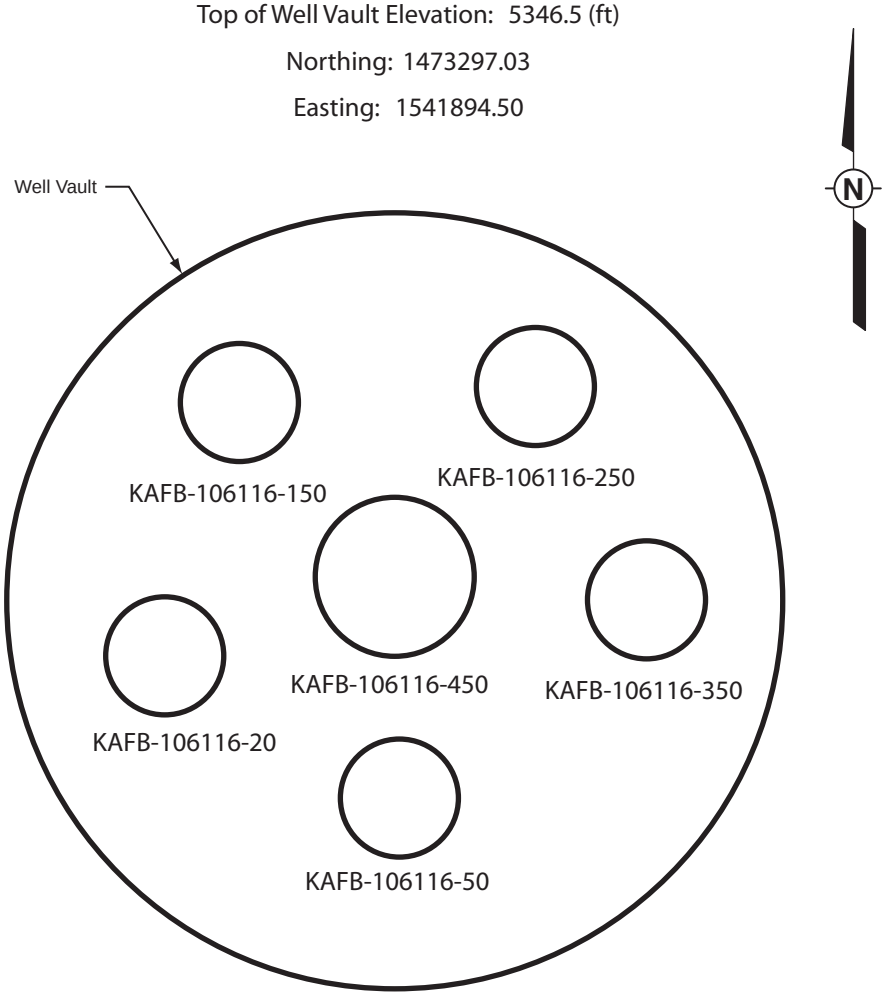
Not to Scale
BGS = Below Ground Surface

Nested Soil Vapor Well Completion Diagram
Map View for KAFB-106116

Top of Well Vault Elevation: 5346.5 (ft)

Northing: 1473297.03

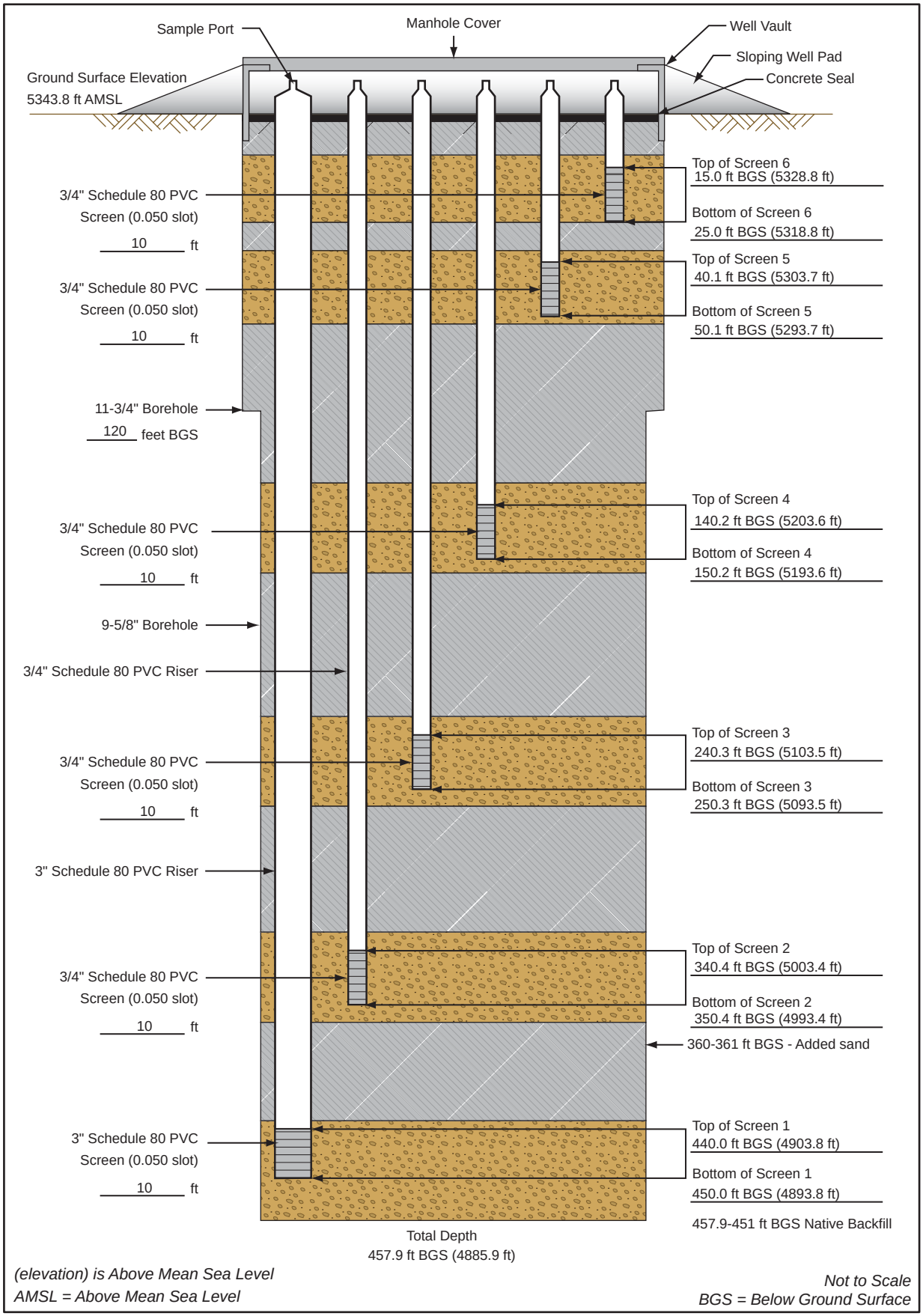
Easting: 1541894.50



Well Number	Well Diameter (in)	Well Depth (ft BGS)	Screened Interval (ft BGS)	Northing	Easting	Elevation (ft AMSL)
KAFB-106116-20	3/4	20.0	10.0 - 20.0	1473296.42	1541894.58	5346.0
KAFB-106116-50	3/4	50.0	40.0 - 50.0	1473296.44	1541894.90	5346.0
KAFB-106116-150	3/4	150.0	140.0 - 150.0	1473296.67	1541894.47	5346.0
KAFB-106116-250	3/4	250.0	240.0 - 250.0	1473296.88	1541894.69	5346.0
KAFB-106116-350	3/4	350.0	340.0 - 350.0	1473296.72	1541894.97	5346.0
KAFB-106116-450	3	450.0	440.0 - 450.0	1473296.72	1541894.69	5346.0

Nested Soil Vapor Well Completion Diagram for KAFB-106128

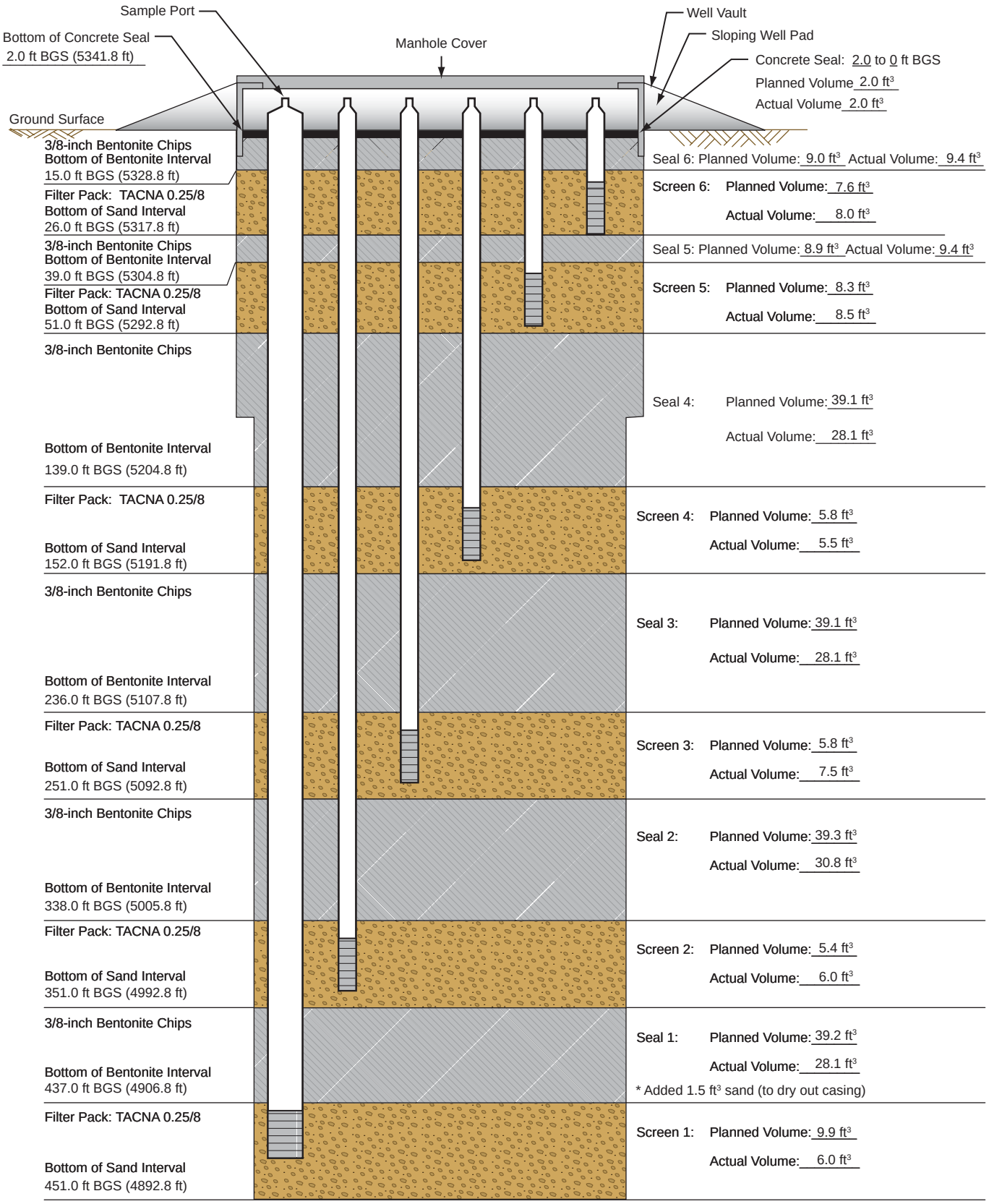
Installation Start Date/Time: 3/7/2011 @ 11:40
Installation End Date/Time: 3/8/2011 @ 17:45



(elevation) is Above Mean Sea Level
AMSL = Above Mean Sea Level

Not to Scale
BGS = Below Ground Surface

Nested Soil Vapor Well Completion Diagram for KAFB-106128



(elevation) is Above Mean Sea Level
All Materials Placed with Tremie Pipe

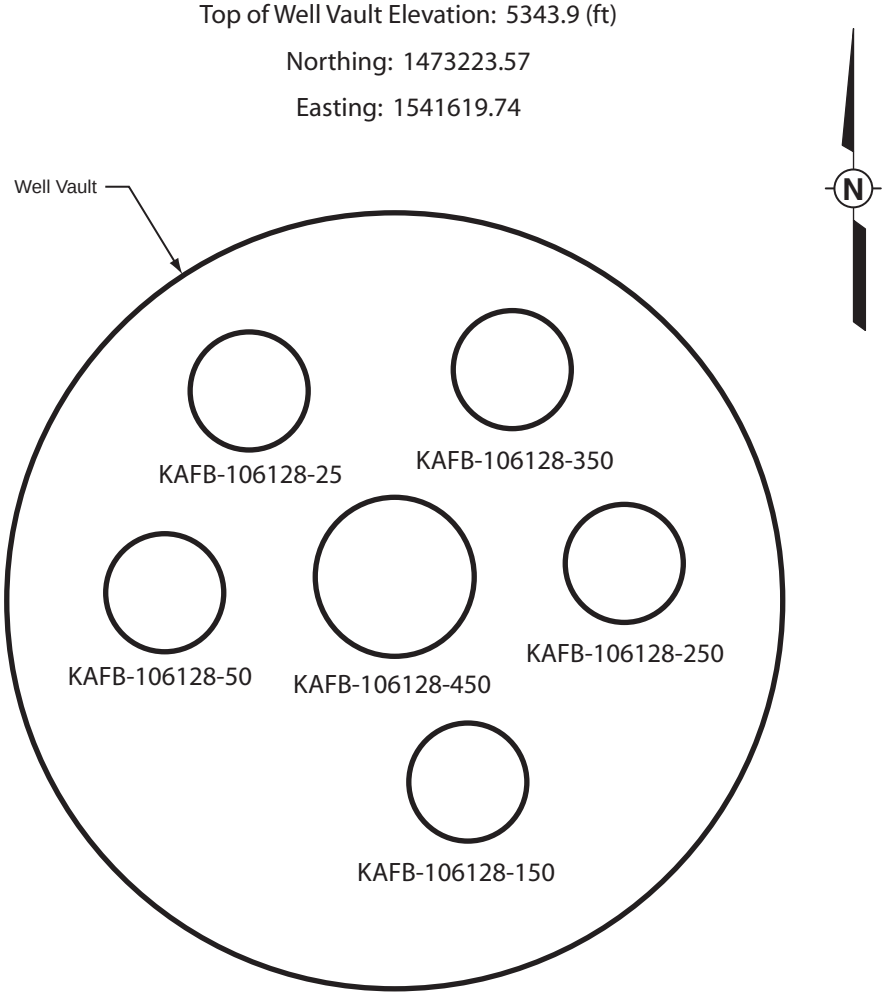
Not to Scale
BGS = Below Ground Surface

Nested Soil Vapor Well Completion Diagram
Map View for KAFB-106128

Top of Well Vault Elevation: 5343.9 (ft)

Northing: 1473223.57

Easting: 1541619.74



Well Number	Well Diameter (in)	Well Depth (ft BGS)	Screened Interval (ft BGS)	Northing	Easting	Elevation (ft AMSL)
KAFB-106128-25	3/4	25.0	15.0 - 25.0	1473223.25	1541619.61	5343.6
KAFB-106128-50	3/4	50.1	40.1 - 50.1	1473222.98	1541619.50	5343.6
KAFB-106128-150	3/4	150.2	140.2 - 150.2	1473222.78	1541619.72	5343.6
KAFB-106128-250	3/4	250.3	240.3 - 250.3	1473222.92	1541619.98	5343.6
KAFB-106128-350	3/4	350.4	340.4 - 350.4	1473223.25	1541619.92	5343.6
KAFB-106128-450	3	450.0	440.0 - 450.0	1473223.15	1541619.72	5343.6

Attachment B – Field Forms

Date:	**Time:**	**Personnel:**	
Well ID:			
Well Diameter:			
Design Injection Rate:			

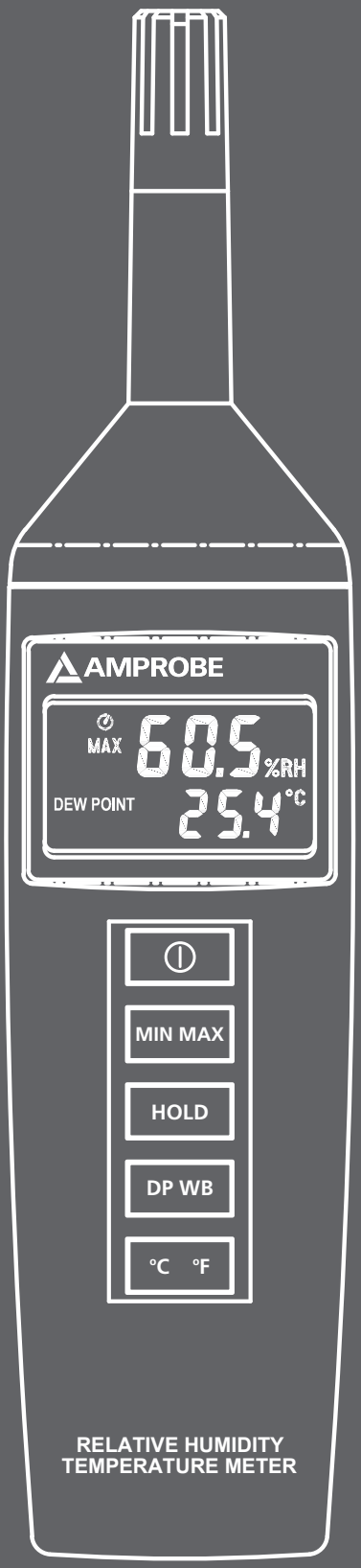
Time	Flowrate (SCFM)	Pressure (PSI)	Volume (FT^3)	Flowrate (SCFM)	Pressure (PSI)	Volume (FT^3)	Flowrate (SCFM)	Pressure (PSI)	Volume (FT^3)

Notes:

Date:	**Time:**				**Personnel:**			
Well ID:								
Date & Time	Flowrate (SCFM)	Vacuum (in-WC)	Volume (FT^3)	VOC (ppmv)	O_2 (%)	CO_2 (%)	RH (%)	Temp (F°)
Notes:								

Attachment C – Manufacturer's Specifications

AMPROBE®



THWD-3
TH-3

Relative Humidity and Temperature Meters

User Manual

ENG GER FRE

ITA SPA SWE

AMPROBE®

THWD-3 and TH-3
Relative Humidity and Temperature Meters

English

12/2017, 6009982 Rev C

Contents

Relative Humidity Temperature Meters

The THWD-3 and TH-3 are instruments to measure relative humidity and temperature. The extended probe allows the user to make measurements inside ducts or hard to reach areas. The Relative and MIN/MAX functions enable measurements to be made in two different areas and then compared. The large dual display and Data Hold function both make viewing the measurement results convenient. Both models utilize a capacitive sensor for humidity measure temperature in °C or °F with 0.1 %RH resolution. Both meters utilizes a capacitive sensor for humidity measurements up to 100% with a tenth percent resolution. With an auto power off feature to save battery life, protective cap for sensor life, vinyl carry case for transportation and battery installed, the TH-3 is the right choice for your atmospheric humidity measurement needs. Model THWD-3 has two extra features with the capability to also indicate Dew Point and Wet Bulb readings.

Safety Information

This meter has been designed and tested according to:

- EN50081-2
- EN50082-2

Symbols Used in this Manual

	Caution! Refer to the explanation in this Manual
	Caution! Risk of electric shock
	Conforms to relevant Australian standards
	Complies with European Directives
	Power ON / OFF
	Do not dispose of this product as unsorted municipal waste

Operating Instructions

Power-Up

• Press the ⏻ key to turn the Humidity/Temperature meter ON or OFF.

Selecting Temperature Units

When the meter is first powered on, the default scale setting is set to the Celsius (°C) scale. To change to Fahrenheit (°F) press the °C °F button. Press again to revert to Celsius. The next time the meter is turned on, the scale setting will be the same as it was when you powered off last time.

Data-Hold Operation

The present reading may be held on the display by pressing the HOLD button. When the held data is no longer needed, release the data-hold operation by pressing the HOLD button again. When the meter is in the Data Hold mode, the △REL, MIN MAX, and °C °F buttons are disabled.

Relative Operation (TH-3 only)

Pressing the △REL button causes the meter to memorize the present reading. The difference between the new reading and the memorized data will be displayed. Press the △REL button again to exit the Relative mode.

MIN/MAX Operation

Pressing the MIN MAX button places the meter in the MIN/MAX mode. In this mode the maximum value and minimum value is kept in the memory simultaneously and updated with every new data reading. Pressing the MIN MAX button displays the MAX indicator and the Maximum value on the display. Pressing MIN MAX again will display the MIN indicator and the Minimum value on the display. Pressing MIN MAX again causes the MAX and MIN indicators to blink together. This means that these data have been updated in the memory and the reading is the present temperature and humidity. When the meter is in MIN/MAX mode, the △REL and °C °F buttons are disabled. To exit MIN/MAX mode, press and hold MIN MAX for two seconds.

Dew Point and Wet Bulb Temperature (THWD-3 only) Operation

The Meter displays ambient temperature when first turned on. To display dew point (DP) temperature, press DP WB once. Press DP WB again to switch to wet bulb (WB) temperature. Pressing DP WB a third time returns the Meter to ambient temperature. The display indicates when dew point and wet bulb temperatures are selected.

Auto Power Off

By default, when the meter is powered on, it is in the auto power off mode. The meter will power itself off after 30 minutes if no key operation is performed. To disable the auto power off feature, press and hold the HOLD button and then power on the meter, The auto power off symbol will disappear to indicate that auto power off is disabled.

Low Battery Condition

When the battery voltage is under proper operation requirement, the symbol displays on the LCD and the battery needs to be replaced.

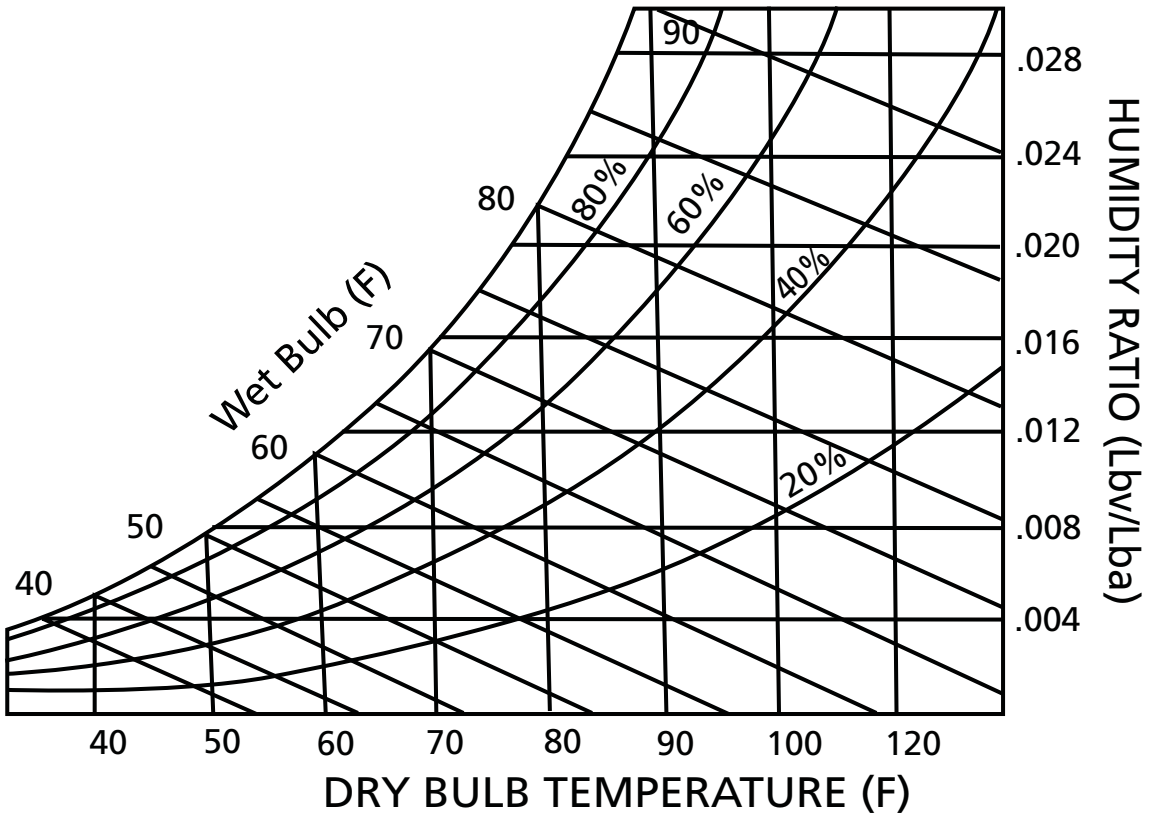
Wet Bulb Temperature Readings (TH-3)

Occasionally the Wet Bulb temperature is required. Use the following procedure and your TH-3 to obtain the wet bulb temperature.

1. Determine RH% condition with the TH-3.
2. Determine temperature (dry-bulb) with the TH-3.
3. Locate dry bulb (DB) temperature line on the Psychrometric chart (vertical line across the bottom of the chart).
4. Locate relative humidity (RH) line on the chart (curved line across the chart).
5. Find the intersection of the DB and RH lines on the chart.
6. Draw a diagonal line, starting at your intersectioin point, until the Wet Bulb (WB) point is determined. (The wet bulb temperature line is at the outmost curve of the chart).

For example, locate the DB temperature of 78 °F on the Psychrometer chart. Locate the RH conditions of 50% RH on the chart. Draw a diagonal line up to the 65 °F WB point.

Psychrometric Chart



Humidity Sensor Reconditioning

If the unit is found to be out of specification for humidity, the sensor could be offset due to long exposure in a dry environment. This condition is typical of polymer type humidity sensors. The sensor will need to be rehydrated.

To rehydrate the sensor, keep it in a 20 °C to 30 °C environment that is >75% RH for at least 12 hours.

Recall Factory Calibration Data

1. Turn OFF the meter.
2. Press and hold "**°C/°F**" and "**HOLD**" button, then press ⏻ to power ON the meter. The display will blink for 3 seconds. While the display is blinking, press "**MIN MAX**" button to recall factory calibration data.
3. A long beep indicates the meter has reset to factory calibration data.

Limited Warranty and Limitation of Liability

Your Amprobe product will be free from defects in material and workmanship for 1 year from the date of purchase. This warranty does not cover fuses, disposable batteries or damage from accident, neglect, misuse, alteration, contamination, or abnormal conditions of operation or handling. Resellers are not authorized to extend any other warranty on Amprobe's behalf. To obtain service during the warranty period, return the product with proof of purchase to an authorized Amprobe Test Tools Service Center or to an Amprobe dealer or distributor. See Repair Section for details. THIS WARRANTY IS YOUR ONLY REMEDY. ALL OTHER WARRANTIES - WHETHER EXPRESS, IMPLIED OR STAUTORY - INCLUDING IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, ARE HEREBY DISCLAIMED. MANUFACTURER SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, ARISING FROM ANY CAUSE OR THEORY. Since some states or countries do not allow the exclusion or limitation of an implied warranty or of incidental or consequential damages, this limitation of liability may not apply to you.

Repair

All test tools returned for warranty or non-warranty repair or for calibration should be accompanied by the following: your name, company's name, address, telephone number, and proof of purchase. Additionally, please include a brief description of the problem or the service requested and include the test leads with the meter. Non-warranty repair or replacement charges should be remitted in the form of a check, a money order, credit card with expiration date, or a purchase order made payable to Amprobe® Test Tools.

In-Warranty Repairs and Replacement – All Countries

Please read the warranty statement and check your battery before requesting repair. During the warranty period any defective test tool can be returned to your Amprobe® Test Tools distributor for an exchange for the same or like product. Please check the "Where to Buy" section on www.amprobe.com for a list of distributors near you. Additionally, in the United States and Canada In-Warranty repair and replacement units can also be sent to a Amprobe® Test Tools Service Center (see address below).

Non-Warranty Repairs and Replacement – US and Canada
Non-warranty repairs in the United States and Canada should be sent to a Amprobe® Test Tools Service Center. Call Amprobe® Test Tools or inquire at your point of purchase for current repair and replacement rates.

In USA
Amprobe Test Tools
Everett, WA 98203
Tel: 877-AMPROBE (267-7623)

In Canada
Amprobe Test Tools
Mississauga, ON L4Z 1X9
Tel: 905-890-7600

Non-Warranty Repairs and Replacement – Europe
European non-warranty units can be replaced by your Amprobe® Test Tools distributor for a nominal charge. Please check the "Where to Buy" section on www.amprobe.com for a list of distributors near you.

European Correspondence Address*
Amprobe® Test Tools Europe
In den Engematten 14
79286 Glottertal, Germany
Tel.: +49 (0) 7684 8009 - 0

*(Correspondence only – no repair or replacement available from this address. European customers please contact your distributor.)

Specifications

Display: Dual display
Operating Conditions: 0°C to 40°C; <80% RH
Storage Conditions: -10°C to 60°C; <70% RH
Altitude: Up to 2000 meters, Indoor operation.
Sample Rate: 2.5 times per second
Battery: 9 V Battery, NEDA 1604 or JIS 006P or IEC6F22
Battery Life: 85-hours continuous; (with alkaline battery)
Dimension: 240x54x34 mm (9.5x2.1x1.3 in)
Weight: Approx.180g (6.4 oz.)
Accessories: Battery, instruction manual

TH-3, THWD-3

Humidity:	0% RH to 99% RH at 23°C
	0˚C to 55˚C
	32˚F to 131˚F
Range	**Accuracy**
10% RH to 90% RH	± 3% RH
<10, >90 %RH	± 5% RH

Temperature Coefficient: 0.1x(specified accuracy)/ °C (<23 °C or >23 °C)
Sensor hysteresis: +/-1 %RH
Resolution: 0.1%RH
Response Time (@ t90; in slowly moving air): 180 sec

TH-3, THWD-3
Temperature:

Range	**Accuracy**
-20°C to 60°C	± 0.8 °C
-4°F to 140°F	± 1.6°F

THWD-3

Wet Bulb Temperature:

Range	**Accuracy**
0°C to 55°C	± 0.8 °C
32°F to 131°F	± 1.6°F

Dew Point Temperature:

0°C to 55°C	± 0.8 °C
32°F to 131°F	± 1.6°F

Resolution: 0.1°C / 0.1°F

Response Time (@ t90; in slowly moving air): 10 sec

Visit amprobe.com for

- **Catalog**
- **Application notes**
- **Product specifications**
- **User manuals**

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Please
Recycle

Brooks® 2500 Series Flowmeters

2500 Series

Brooks® Models 2510, 2520, 2530 & 2540

Acrylic block flowmeters are available in various sizes and ranges, with direct reading scales in both SAE and SI units for air and water. For other gases or liquids, special scales can be provided. If you use this meter with fluids other than air or water, please consult chemical compatibility data for possible effects on the meter. These meters are manufactured of durable acrylic and if properly installed and maintained, will provide long-term trouble-free operation.

UNPACKING

Precautions have been taken to prevent any damage from occurring during shipment. However, if the meter is received damaged, report it to the carrier immediately. Before installing, verify that you have the model and flow range required.

INSTALLATION

The Model 2510, 2520 & 2530 meters are supplied with 5/8" or 7/8" hex's on the inlet and outlet fittings. When installing 1/8-27 MNPT or ¼-18 MNPT fittings into the meter, place the appropriate size wrench on the hex to prevent the inlet/ outlet fitting from rotating. Torque only to 60 in-lbs. Failure to do so will cause the fitting to rotate, and may damage the meter body, causing leaks and/or meter failure.

The Model 2540 meters are supplied with round 1-11 ½ FNPT inlet and outlet fittings. When installing the meter, securely hold the meter's fittings from rotating while connecting the flow lines.

Use pipe thread sealant or Teflon® tape to ease installation and provide a better seal.

These meters are supplied with #10-32 threaded inserts for mounting. When installing, use slotted screws and torque to a maximum of 35 in-lbs. Mounting dimensions are shown in Figures 1 & 2.

ACHIEVING ACCURATE FLOWRATES

To obtain an accurate flowrate, the float must be read at the position indicated on the meter. If the meter uses a ball float, the flowrate is determined by reading the center of the ball. Additionally, the flowmeter should be installed in a manner, which minimizes both external vibrations and internal flow variations. Special care should be taken so that the connections to the meter's inlet and outlet fittings do not overly restrict the liquid or gas flow being metered. This could result in a reduced flow volume, preventing the meter from reaching its maximum flowrate. Furthermore, internal pressures could be affected, which can cause inaccurate flow readings. On start-up, slowly purge any fluid trapped in the meter.

CLEANING AND DISASSEMBLY

Occasional cleaning may be required if dirt appears in the flow tube or if float movement becomes restricted. To clean, remove the top plug and remove the float. Wash the tapered hole and top plug with a mild liquid detergent and soft brush. Rinse all parts with clean water and dry thoroughly with clean air or nitrogen. Do not use solvents to clean this meter as they will attack the acrylic and destroy the meter.

REASSEMBLY

Check to make sure that all parts are clean and dry. To lubricate the O-rings, apply a small amount of halocarbon grease prior to reassembly.

If applicable, reinstall the rod guide assembly into the flowmeter body. Make sure the rod guide is seated firmly in the body of the meter for a Standard Back meter or in the inlet fitting of the Inline meter. (For meters with valves, it will be necessary for the rod guide to pass through the slot in the valve tip.) To allow proper use of the valve, do not tighten the valve tip completely on the valve stem. Reinstall the top plug or the outlet fitting, making sure that the rod guide is properly aligned. Tighten top plug until it's flush with top of acrylic body. Exceeding this may damage the meter body.

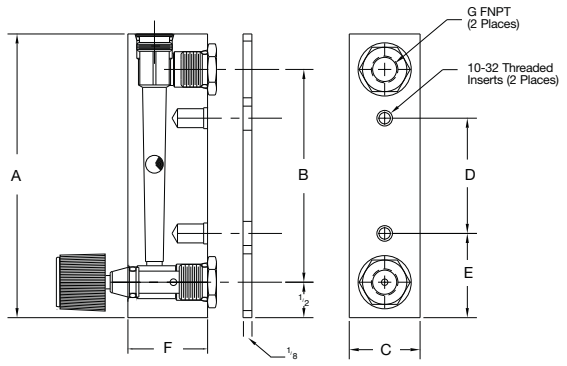
⚠ CAUTION

This flowmeter is designed for use with non-hazardous fluids at pressures up to 100 psi (690 kPa) and temperatures up to 150°F (65°C). Do not use hazardous fluids and do not exceed temperature or pressure limits. Use with hazardous fluids or exceeding the pressure and temperature limits may cause failure which could result in injury.

Brooks® 2500 Series Flowmeters

Table 1 Specifications - 2500 Series

	2510	2520	2530	2540
Accuracy	±5% full scale	±3% full scale		±2% full scale
Floats	Black Glass, 316 Stainless Steel		Stainless Steel	
Body	Clear Acrylic			
Seals	Buna-N O-rings with Brass fittings; Viton® O-rings with 303 Stainless Steel fittings			Buna-N O-rings w/Brass or PVC fittings Viton O-rings w/Stn Stl fittings
Pressure	100 PSIG Max.			
Temperature	150°F/65°C Max.			
Fittings	Brass, 303 Stainless Steel			PVC FNPT Pipe Connections (Std.)
Valves	Brass or Stainless Steel			Integral Valve on "V" models Inline Gate Valve is available for "S and I" models
Certifications	International Calibration Certificate (ICC); Pressure Equipment Directive (97/23/EC); RoHS			

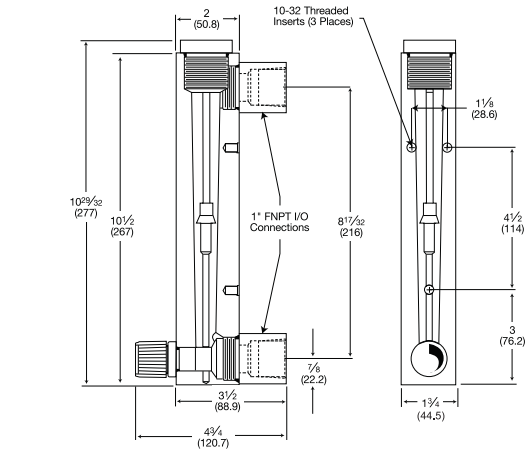


Dimensions - Inches (MM)

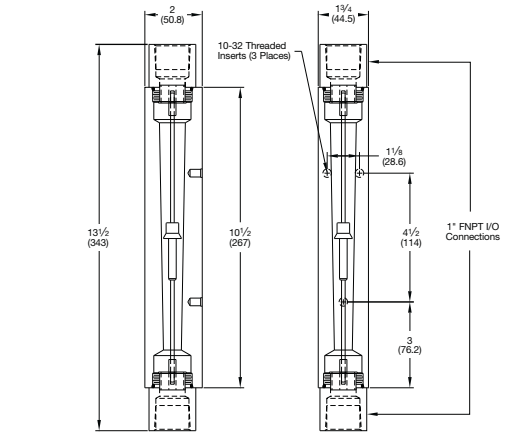
Model	A	B	C	D	E	F	G
2510	4" (102)	3" (76.2)	1" (25.4)	1-5/8" (41.3)	1-3/16" (30.2)	1-1/8" (28.6)	1/8" FNPT
2520	6-1/2" (165)	5-1/2" (140)	1-3/8" (34.9)	3-1/2" (88.9)	1-1/2" (38.10)	1-1/8" (28.6)	1/8" FNPT
2530*	6-5/8" (168)	5-1/2" (140)	1-1/8" (28.6)	3-1/2" (88.9)	1-1/2" (38.1)	1-3/8" 34.9)	1/4" FNPT

* Does not include 1/8" back plate

Figure 1 Dimensions - Model 2510, 2520 & 2530



Model 2540-S or V



Model 2540-I

Figure 2 Dimensions - Model 2540

ISO 9001 QUALITY SYSTEM

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A list of all Brooks Instrument locations and contact details can be found at www.BrooksInstrument.com

BROOKS® INSTRUMENT

Series 477A Handheld Digital Manometer

Specifications - Installation and Operation Instructions

Series 477A Digital Manometers are versatile, hand-held, battery operated manometers available in several basic ranges from 0-20 in. w.c. up to 100 psi. All models measure either positive, negative or differential pressures with ±0.10% of full scale accuracy. You can select from up to seven common English and metric pressure units so conversions are not necessary. A memory function allows storage of up to 40 readings for later recall and a backlight provides auxiliary lighting for hard-to-see locations. Also standard are a hold feature plus both visual and audible overpressure alarms.

SPECIFICATIONS

Service: Air and compatible gases.
Wetted Parts: Consult factory.
Accuracy: ±0.10% of full scale from 60 to 78°F (15.6 to 25.6°C); ±1% of full scale from 32 to 60 and 78 to 104°F (0 to 15 .6 and 25.6 to 40°C).
Pressure Hysteresis: ±0.1% of full scale.
Pressure Limits: See chart.
Temperature Limits: 32 to 104°F (0 to 40°C).
Storage Temperature Limits: -4 to 176°F (-20 to 80°C).
Display: 4-digit LCD (.425″ H x .234″ W digits).
Resolution: See chart.
Power Requirements: 9 volt alkaline battery. Battery included but not connected.
Weight: 10.2 oz. (289 g).
Connections: Two barbed connections for use with 1/8″ (3.18 mm) or 3/16″ (4.76 mm) I.D. tubing for 477A-1, 477A-2, 477A-3, 477A-4 and 477A-5 only. Two compression fittings for use with 1/8″ (3.18 mm) I.D. x 1/4″ (6.35 mm) O.D. tubing for 477A-6 and 477A-7 only.

Model Number	English Range	Metric Range
477A-1	0-20.00 in. w.c.	0-4.982 kPa
477A-2	0-40.00 in. w.c.	0-9.96 kPa
477A-3	0-200.0 in. w.c.	0-49.82 kPa
477A-4	0-10.00 psi	0-68.95 kPa
477A-5	0-30.00 psi	0-206.9 kPa
477A-6	0-50.00 psi	0-344.8 kPa
477A-7	0-100.0 psi	0-689.5 kPa

Maximum Pressure	
477A-1	3 psi (0.21 bar)
477A-2	3 psi (0.21 bar)
477A-3	15 psi (1.03 bar)
477A-4	30 psi (2.07 bar)
477A-5	60 psi (4.13 bar)
477A-6	100 psi (6.89 bar)
477A-7	200 psi (13.78 bar)

Available Pressure Units:

477A-1 & 477A-2: psi, in. w.c., mm w.c., in. Hg, mm Hg, Pa, kPa, bar, mbar

477A-3 & 477A-4: psi, in. w.c., mm w.c., in. Hg, mm Hg, kPa, bar, mbar

477A-5, 477A-6 & 477A-7: psi, in. w.c., in. Hg, mm Hg, kPa, bar, mbar

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Phone: 219/879-8000 www.dwyer-inst.com
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INSTRUCTIONS

Battery Installation

The unit is shipped with a separate 9 volt alkaline battery which must be installed before operation. Remove the two screws holding the bottom endcap in place and remove the endcap. Connect the battery to the enclosed battery clip observing correct polarity. Be careful not to trap wires between the battery, case or foam pads which retain the battery. This could make it difficult to install the battery or remove it later for replacement. Be sure the rubber gasket is properly seated in the gasket channel of the endcap and replace endcap. Note that the endcap will only fit one way because the holes are slightly off-center. Place the "Z" shaped wrist strap clip in one of the screw recesses and replace the screws. Do not overtighten the screws. Attach wrist strap to clip.

When battery replacement becomes necessary, use only a 9 volt alkaline type such as a Duracell® MN1604, Eveready® 522 or equivalent. Zinc-carbon types, often labeled Heavy-duty are not recommended because of the increased potential for leakage. Alkaline batteries are also a better value because they last up to three times longer in this device.

On-Off Operation

The on-off control is a toggle function. Press and release the ON/OFF key once to turn unit on; again to turn it off. If the manometer is left on with no activity for approximately 20 minutes, unit will turn itself off to conserve the battery.

Display Backlight

The Model 477A includes a display backlight to allow use in the dark or in poor lighting conditions. Manometer must be switched off before this feature can be activated. Next, press and hold the ON/OFF key down. After about 1 second the backlight will come on and remain lighted for approximately 2 minutes after which it will turn itself off to conserve battery life.

Zeroing Pressure Reading

Potential inaccuracy due to temperature effects can be minimized by re-zeroing immediately before use. To zero the display, vent both ports to atmosphere so no pressure is applied to either port. Press the ZERO/STORE key and - - - - will be momentarily displayed as zeroing occurs. Zeroing is not possible when the memory mode is in use. It must be done before selecting that function.

If the unit is accidently zeroed with pressure applied to one of the ports, the pressure reading might display incorrectly. To correct, vent the pressure ports to atmosphere and press the ZERO/STORE key to zero the unit.

Pressure Connections

To measure single positive pressure, connect tubing to port marked + and vent opposite port to atmosphere. To measure differential positive pressure, connect higher positive pressure to port marked + and lower positive pressure to port marked -. Manometer will indicate the difference between the two.

Selecting Pressure Units

Up to seven pressure units are available. The display will indicate the current selection. To change to different units, use the UNITS/LOC key. Each touch will cause an advance to the next choice. The selected units will remain in memory even when power is shut off. This way, your preference will always be displayed after the initial selection.

Display Hold

There may be situations where you want to temporarily retain a reading. The Model 477A includes a Display Hold feature which freezes the current reading and holds it in the display until cleared. To activate this operation, momentarily press the HOLD/MEMORY key when the pressure you want to save is displayed. A HOLD indicator will appear in the display to indicate that the reading shown is frozen. To return to normal operation, press the HOLD/MEMORY key again.The HOLD indicator will disappear and the current pressure will again be shown.

Memory Function

A memory function is included in the Model 477A that allows you to store up to 40 pressure readings for later review or recording. This feature is especially valuable for making a traverse of duct velocity pressures with a Pitot tube or for multipoint pressure measurements. The readings are stored in non-volatile memory so they will be retained even if the unit is shut off or the battery is removed.

Storing Pressure Readings

To store a reading, press and hold the HOLD/MEMORY until ST01 is displayed then release the key. Next, press ZERO/STORE key to save current reading to ST01 memory location. A beep will sound indicating that the reading has been saved. As each reading is saved, the memory location display will advance to the next number. To resume pressure measurement, press the HOLD/MEMORY key again. Note that in the memory mode, the display zero function is not available. To zero the display, you must first exit the memory mode and then press the ZERO/STORE key.

Viewing Stored Readings - Selecting a Location

To view the contents of memory, press and hold the HOLD/MEMORY until RD01 is displayed then release the key. Next, press UNITS/LOC to view other memory location. To resume pressure measurement, press the HOLD/MEMORY key again.

Clearing Memory

To clear the contents of memory, press and hold the HOLD/MEMORY until CLR is displayed then release the key. Next, press ZERO/STORE key to clear all previously stored readings. During this operation - - - - will be displayed. Once memory is cleared, the current pressure will be displayed.

Exiting Memory Mode

To exit the memory mode press the HOLD/MEMORY key again and the unit will return to normal operation.

Dampening Function

The dampening feature allows the user to enter a dampening number from 1 to 16 (default value = 2). Entering a larger number increases the amount of readings that are averaged for each display update.

In order to access the dampening feature, follow the instructions below:

1. Press and hold the HOLD/MEMORY button. The upper right portion of the LCD scrolls through a menu selection (HOLD, ST01, RD01, CLR, and DAMP). When "DAMP" is shown, release the HOLD/MEMORY button. This selects the dampening feature.

2. Once "DAMP" is selected, a number is shown in the upper right portion of the LCD, along with the current pressure reading. This number is the dampening number. Adjust the number up by pressing the ZERO/STORE button or down by pressing the UNITS/LOC button. The LCD update rate slows as the number increases from 1 to 16. Therefore, for best results, choose the smallest number that provides a stable pressure reading.

Once the pressure reading is stable, press and release the HOLD/MEMORY button to store the dampening value.

Overpressure Alarm

A visual indicator and audible alarm are provided to alert the operator that pressure has exceeded the operating range of the unit. Exceeding the range will not damage it or affect calibration as long as the maximum rated pressure is not exceeded. ***Do not exceed the maximum rated pressure of the manometer. Doing so will cause permanent damage to the sensor, may rupture the housing and/or cause injury.*** The maximum pressure is shown on the rear label and on page 1 of these instructions.

Low Battery Indicator

A weak battery can cause improper operation or inaccurate measurements. A low battery indicator is provided on the display to show when the battery needs replacement. Although the unit might appear to function and indicate properly, the accuracy of readings cannot be guaranteed when the LOW BAT indicator is illuminated. Replace the battery with a fresh one. Do not leave an exhausted battery in the unit due to potential leakage.

MAINTENANCE

The Series 477A handheld digital manometers are not field repairable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

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C-DLR

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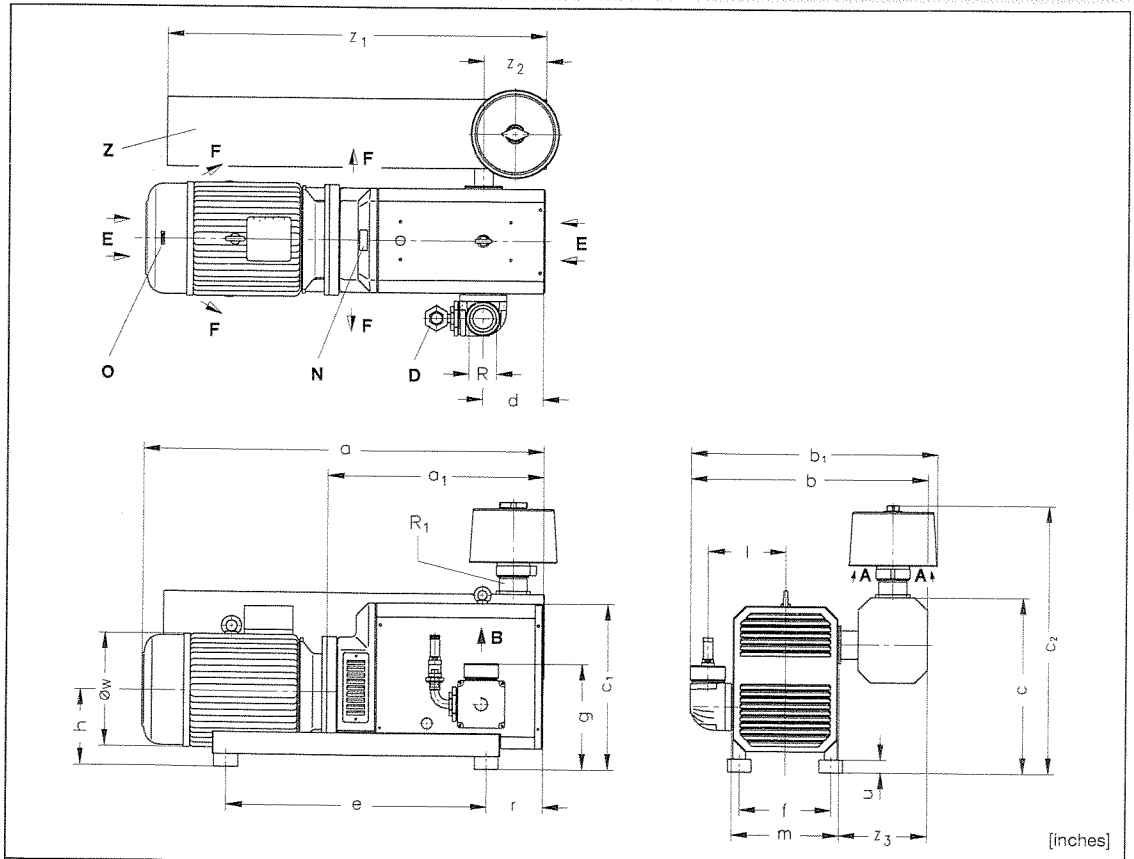
- C-DLR 60
- C-DLR 100
- C-DLR 150



[inches]

A	Suction	Succión	Aspiration	Sucção
B	Pressure connection	Conexión presión	Raccord surpression	Conexão da pressão
D	Safety valve	Válvula seguridad	Clapet de sécurité	Válvula de segurança
E	Cooling air entry	Entrada aire refrigerante	Entrée air refroidissement	Entrada do ar refrigerante
F	Cooling air exit	Salida aire refrigerante	Sortie air refroidissement	Saída do ar refrigerante
N	Data plate	Placa fecha	Etiquette caractéristique	Placa da data
O	Rotation arrow	Dirección de rotación	Flèche sens rotation	Direção da rotação
Z	Inlet silencer	Silenciador entrada	Silencieux d'aspiration	Silenciador de entrada

C-DLR		60	100			150	
kw	50 Hz	3.0	3.0	4.0	5.5	5.5	7,5
hp	60 Hz	5.0	5.0	7.5	10	10	15
inches	a 50 Hz	27.44	27.36	28.03	32.17	36.26	
	a 60 Hz	27.44	31.49	33.07	33.07	36.34	37.40
	a_1 50 Hz	15.28	15.43	15.43	16.22	19.49	
	a_1 60 Hz	15.28	17.56	17.56	17.56	20.83	
	b / b_1	13.70 / 13.70	21.26 / 22.05			21.30 / 22.05	
	c / c_1 / c_2	15.04 / 11.61 / 15.04	14.76 / 14.17 / 25.75			18.39 / 14.76 / 25.75	
	d	2.36	3.62			2.28	
	e	9.65	17.32			15.04	
	f	6.30	8.66			6.30	
	g	11.73	8.23			9.41	
	h	6.10	5.91			6.50	
	l	5.43	7.17			7.17	
	m	6.46	10.00			10.00	
	r / u	4.21 / 0.79	3.03 / 0.59			4.56 / 1.18	
	øw 50 Hz	7.72	7.72	8.66	9.69	9.69	
	øw 60 Hz	7.87	7.88	9.57	9.57	9.57	11.47
	z_1	-	24.65			24.65	
	z_2 / z_3	-	3.94 / 7.28			3.94 / 7.28	
	R / R_1	1" NPT / BSP 1"	1½" NPT / BSP 1½"			1½" NPT / BSP 1½"	

DA 881/1

1.2.2006

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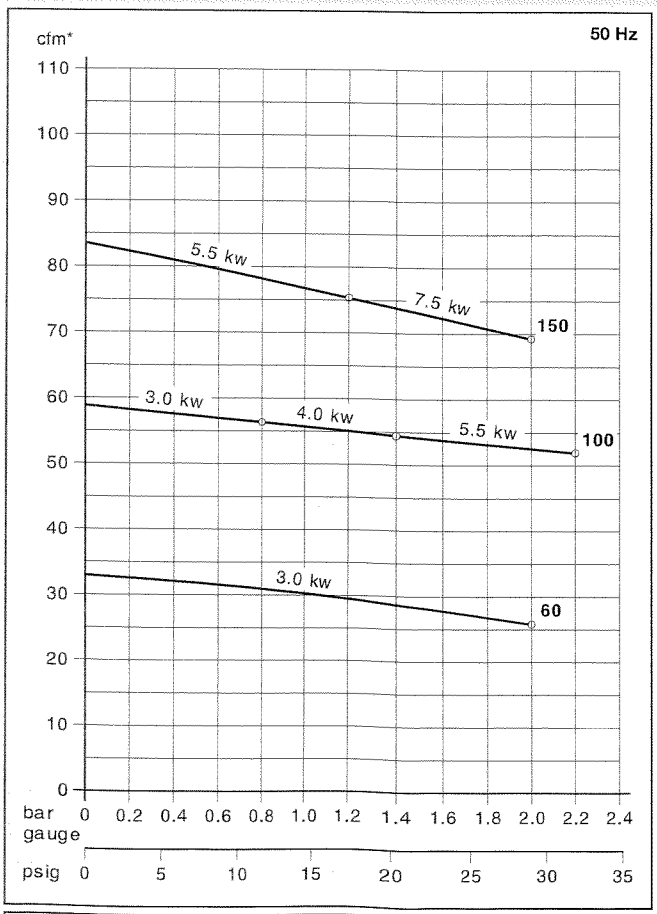
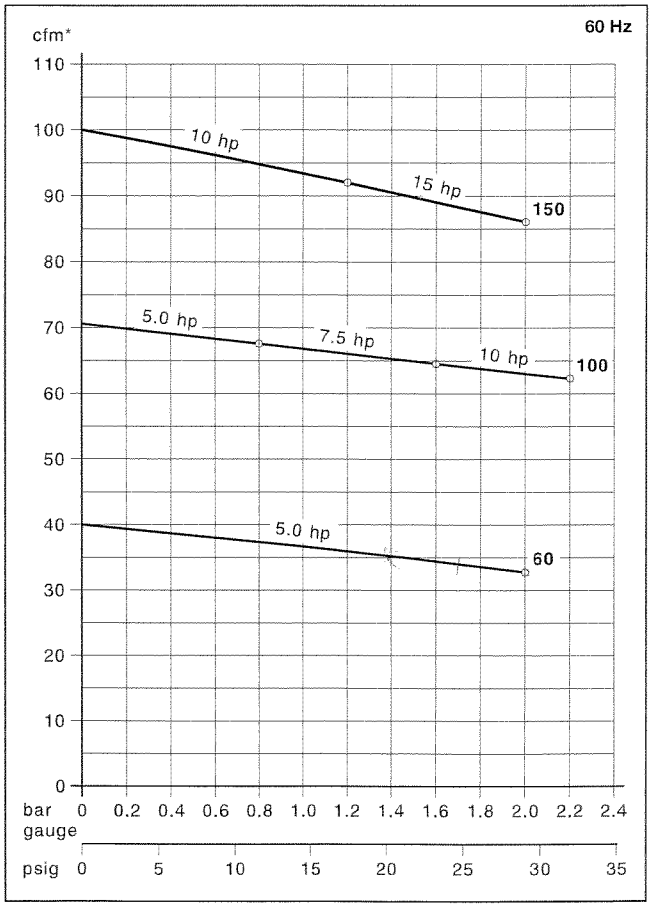
e-mail: sales.hanover@gardnerdenver.com
www.gd-elmorietschle.com

C-DLR		60	100			150	
cfm	50 Hz	33.0	58.9			83.6	
	60 Hz	40.0	70.6			100	
psig	50 Hz	29.0	11.6	20.3	31.9	17.4	29.0
	60 Hz	29.0	11.6	23.2	31.9	17.4	29.0
3~	50 Hz	230/400V ± 10%			400/690V ± 10%		
	60 Hz	208-230/415-460V ± 10%	208-230/460V ± 10%				
kw	50 Hz	3.0	3.0	4.0	5.5	5.5	7.5
hp	60 Hz	5.0	5.0	7.5	10	10	15
A	60 Hz	15/7.5	13.2-12/6.0	21-18.8/9.4	25-24/12	25-24/12	39-37/18.5
rpm	50 Hz	2850					
	60 Hz	3450					
dB(A)	50 Hz	78	79			80	
	60 Hz	79	83			81	
lbs	50 Hz	143	232	243	287	333	333
	60 Hz	143	259	286	307	345	423
qt		0.4	0.55			0.6	

ZRZ	#	40	40
ZDR	#	40	40
ZPD	-	-	-
ZMS / ZAD	#	#	#

cfm	Capacity	Capacidad	Volume engendré	Capacidade
psig	Excess pressure	Exceso de presión	Surpression	Pressão excessiva
3~	Motor version	Versión motor	Exécution moteur	Versão do motor
kw / hp	Motor rating	Datos motor	Puissance moteur	Potência do motor
A	Full load amperage	Amperaje de plena carga	Intensité absorbée	Amperagem da carga total
rpm	Speed	Velocidad	Vitesse rotation	Velocidade
dB(A)	Average noise level	Nivel de ruido medio	Niveau sonore moyen	Nível médio de ruído
lbs	Weight	Peso	Poids	Peso
qt	Oil capacity (Gear)	Instrumentos capacidad aceite	Charge d'huile (Engrenage)	Engrenagem da capacidade do óleo
	Accessories	Accesorios	Accessoires	Acessórios
ZRZ	Non return leaf	Válvula retención	Clapet anti-retour	Válvula sem retorno
ZDR	Pressure regulating valve	Válvula reguladora de presión	Valve de réglage pression	Válvula de regulagem da pressão
ZPD	Pulsation silencer	Silenciador de pulsación	Absorbeur de pulsations	Silenciador de pulsação
ZMS	Motor starter	Arranque motor	Disjoncteur moteur	Arranque do motor
ZAD	Soft starter	Soft starter	Démarrage progressif	Soft starter
ZBZ	Sound box	Caja de sonido	Caisson insonorisant	Canópia





* Capacity refers to free air at 1 standard atmosphere and 20° C (68° F)./ La capacidad se refiere al aire libre a 1 atmosfera estandár de presión y a 20° C (68° F) de temperatura./ Le débit est mesuré à l'atmosphère de 1 bar (abs.) à 20° C (68° F)./ A capacidade refere-se ao ar livre a uma atmosfera padrão 1 e a 20° C (68° F).

Curves and tables refer to compressor at normal operating temperature./ Las curvas y las tablas se refieran al compresor a la temperatura normal de operación./ Les courbes et tableaux sont établies, compresseur à température de functionnement./ As curvas e tabelas referem-se ao compressor a temperatura normal de operação.

Technical information is subject to change without notice!/ La información técnica está sujeta a cambios sin previo aviso!/ Sous réserve de modification technique./ A informação técnica está sujeita a mudança sem aviso prévio!

The listed values for a, ø w and full load amperage may vary because of different motor manufacturers./ Los valores listados para a, ø w y para el amperaje de carga completa pueden variar para distintos fabicantes de motores./ Les dimensions a et ø w ainsi que l'ampérage peuvent différer des données indiquées ci-dessus, selon le fabricant du moteur./ Como variam os fabricantes de motores, poderá haver variação dos valores indicados para a, ø w e para uma amperagem da carga total.

on request # on pedido # sur demande # a pedido

7 REFERENCE

7.1 Specifications

7.1.1 System Outline

Model	MEXA-584L
Conformed standards	● ISO3930/OIML R99(2000) Class 0 *1 ● CE ● FCC ● Certified by the Japanese Ministry of Transport
Application	Exhaust gases from gasoline vehicle (two-wheel or four-wheel vehicle), LPG vehicle (four-wheel vehicle)
Principle	● CO, HC, CO_2: non-dispersive infrared (NDIR) ● Air-to-fuel ratio (AFR), Excess air ratio (λ, lambda): carbon balance method, or Brettshneider method (with O_2 measurement) *2
Measured/displayed components	Measured components (standard): ● CO: 0.00 %vol to 10.00 %vol ● HC: 0 ppmvol to 10000 ppmvol, or 0 ppmvol to 20000 ppmvol *3 (as hexane equivalent value) ● CO_2: 0.00 %vol to 20.00 %vol ● AFR: 10.0 to 30.0 ● LAMBDA: 0.000 to 9.999 External input components (optional): ● O_2: 0.00 %vol to 25.00 %vol ● NO: 0 ppmvol to 5000 ppmvol ● Engine speed (RPM): 0 rpm to 9990 rpm (Guaranteed range for linearity is 200 rpm to 6000 rpm) ● Oil temperature (TEMP): 0°C to 150°C
Display resolution	● CO: 0.01 %vol ● HC *2: 1 ppmvol (within the range of 0 ppmvol to 2000 ppmvol), 10 ppmvol (within the range of 2000 ppmvol to 10000 ppmvol) ● CO_2: 0.02 %vol ● AFR: 0.1 ● LAMBDA: 0.001 ● O_2: 0.01 %vol ● NO: 1 ppmvol ● RPM: 10 rpm *4 ● TEMP: 1°C
Monitor display	LCD (black and white, 320 × 240 dot)
Input/output	● Digital input/output: RS-232C (standard), RS-485 (optional) *5 ● Printer: RS-232C

*1: The following functions required by the ISO 3930/OIML R99 standard are intentionally not equipped considering the practical operation by users.
- The instrument is not able to perform the measurement if the value at a leak check and/or HC hang-up test exceeds the limit value.
- The instrument stops the measurement when the pressure in sample gas line is too low (filter alarm).

When such error or alarm is displayed, refer to " 6.4 Trouble Shooting " (page 50) and start measurements after solving problems.

*2: Air-to-fuel ration (AFR) and excess air ratio (λ) are calculated by the carbon balance method in standard configuration. In case that an optional O_2 sensor is connected, the Brettshneider equation is also available. Specify the equation to be used when you order.

*3: For optional range for HC, 20000 ppmvol, display resolution is 2 ppmvol within the range of 0 ppm to 4000 ppm, and 20 ppmvol within the range of 4000 ppmvol to 20000 ppmvol.

*4: Display resolution of RPM is "1 rpm" as for the units which are delivered for India.

*5: Contact HORIBA for quotation on RS-485 connection (optional). For connection an external PC with a communication software which supports USB port, use a RS232C/USB converter on the market.

7.1.2 Configurations/Conditions

Connection of sample gas	Dedicated flexible probe is attached
Sample gas flow rate	Approx. 4 L/min
Sample gas pressure	From 0.0 kPa to 1.0 kPa
Calibration gas	Dedicated cylinder ● Mixed gas of CO, C_3H_8 and CO_2 ● NO (for the instrument with NO analyzer (optional))
Environment for operation	● Ambient temperature: 0°C to 45°C 5°C to 40°C (for OIML conformity) ● Humidity: Below 90% as relative humidity ● Ambient pressure: 80 kPa to 106 kPa (–300 m to 2100 m as altitude)
Environment for storage	● Ambient temperature: –30°C to 60°C ● Humidity: Below 90% as relative humidity, without water condensation
Power supply *1	100 V to 240 V AC, 50 Hz to 60 Hz, single phase
Power capacity	Approx. 90 VA at stable state
Dimensions	260 (W) × 357 (D) × 157 (H) mm (without optional units)
Mass	Approx. 4 kg (without optional units)

*1: For using the analyzer with a DC power source, prepare a DC/AC inverter on the market.

7.1.3 Performance

Response speed *1,2	CO, HC, CO_2:	Within 15 s, as Td + T_{95}, when switching zero gas and span gas	
	O_2:	Within 15 s, as Td + T_{95}, when switching air to zero gas	
	NO:	Within 40 s, as Td + T_{95}, when switching zero gas and span gas	
Linearity *3	CO:		Within 0.03 %vol, or within 3% of reading (whichever is larger)
	HC:		Within 10 ppmvol, or within 5% of reading (whichever is larger)
	CO_2	(0.00 %vol to 8.00 %vol):	Within 0.3 %vol, or within 5% of reading (whichever is larger)
		(8.01 %vol to 15.00 %vol):	Within 0.4 %vol
		(15.01 %vol to 16.00 %vol):	Within 0.6 %vol
		(16.01 %vol to 20.00 %vol):	Within 4% of reading
	O_2:		Within 0.1 %vol, or within 3% of reading (whichever is larger)
	NO	(0 ppmvol to 4000 ppmvol):	Within 25 ppmvol, or within 4% of reading (whichever is larger)
		(4001 ppmvol to 5000 ppmvol):	Within 8% of reading
	RPM	(200 rpm to 6000 rpm):	Within ±10 rpm
	TEMP:		Within ±2°C
Repeatability *1,4	CO:	Within 0.01 %vol, or within 1.7% of reading (whichever is larger)	
	HC:	Within 3.3 ppmvol, or within 1.7% of reading (whichever is larger)	
	CO_2:	Within 0.17 %vol, or within 1.7% of reading (whichever is larger)	
Warm-up time	5 minutes		
Warm-up condition *1,5	CO:	Within 0.03 %vol, or within 5% of reading (whichever is larger)	
	HC:	Within 10 ppmvol, or within 5% of reading (whichever is larger)	
	CO_2:	Within 0.4 %vol	
Drift *1,6	CO:	Within 0.03 %vol, or within 5% of reading (whichever is larger)	
	HC:	Within 10 ppmvol, or within 5% of reading (whichever is larger)	
	CO_2:	Within 0.4 %vol	

Interference effect		Test gas			
		CO 6 %vol	C_3H_8 4000 ppmvol	CO_2 16 %vol	H_2O 20°C ±2°C saturation
	CO	--	Within 0.02 %vol	Within 0.02 %vol	Within 0.02 %vol
	HC	Within 5 ppmvol	--	Within 5 ppmvol	Within 5 ppmvol
	CO_2	Within 0.25 %vol	Within 0.25 %vol	--	Within 0.25 %vol

Power supply voltage fluctuation effect *1,7	CO:	Within 0.02 %vol, or within 2.5% of reading (whichever is larger)
	HC:	Within 5 ppmvol, or within 2.5% of reading (whichever is larger)
	CO_2:	Within 0.25 %vol, or within 2.5% of reading (whichever is larger)
Propane equivalent factor of HC readings	Between 0.490 and 0.540	

*1: Span gas for the performance test shall be approx. 0.5 %vol for CO, 200 ppmvol for C_3H_8 and 14 %vol for CO_2.

*2: When calibration gases are switched at sample inlet with the optional probe attached.

*3: Linearity of gas component is defined as the maximum reading error when below standard gases are used after zero/span calibration. Ambient temperature for linearity test shall be within 20°C ±2°C for gas components, and 25°C ±2°C for "RPM" and "TEMP". Performance of external input components (O_2, NO, RPM and TEMP) are guaranteed only for the sensors specified below.

- CO: 0.5 %vol, 1 %vol, 3.5 %vol, 5 %vol
- C_3H_8: 200 ppmvol, 600 ppmvol, 2000 ppmvol
- CO_2: 6 %vol, 10 %vol, 14 %vol
- O_2: 0.5 %vol, 10 %vol, 20.9 %vol
- NO: 200 ppmvol, 800 ppmvol, 4500 ppmvol

*4: Repeatability is described as the standard deviation of values of 20 repeated measurements.

*5: Maximum reading error directly after completing the warm-up, then two minutes, five minutes and 15 minutes.

*6: Maximum reading error for zero/span gas measurement done at 30-minute intervals from first 30 minutes after warm-up completion to next four hours.

*7: Maximum reading effect where power fluctuates within the 85% to 110% of specified range (100 V to 240 V AC).

7.1.4 Options

O_2 sensor *1	Electrochemical cell sensor; Teledyne, model: R22-A
NO sensor *1	Electrochemical cell sensor; City Technology, model: NX1
Thermometer tachometer *2	Thermometer tachometer; Capelec, ● Model: CAP8950 ● Connection: to be connected by RS-232C ● Cable length: 0.5/1/3/5/7/10 m (to be specified for order)
Tachometer *2,3	Clamp sensor; Tecnotest, ● Model: SL06003 ● Cable length: 5.0 m ±0.2 m
Oil temperature sensor *3	Tecnotest; ● Model: SL51080 898 ● Cable length: 5.0 m ±0.2 m
Printer	Serial printer; Model: CBM-910II-24RJ-100A (for 100 V AC) CBM-910II-24RF-120A (for 120 V AC) CBM-910II-24RF-230A (for 230 V AC)
Printer cable	RS-232C cable, 1.5 m
External communication software	To be installed in an external PC with Windows XP/Vista-OS and a RS-232C serial port *4
Input/output cable	RS-232C cable; 2.5 m, 5 m, 10 m
Analog output board	0 V to 1 V
Optional probe	6 mm O.D./4 mm I.D, copper pipe
Drain separator	Separately attached

*1: Warranty period for the optional sensors (O_2 sensor and NO sensor specified above) is one year (at 20.9 %vol O_2, 25°C, 50% as relative humidity) after delivery in case that they are supplied by HORIBA. If the sample gas contains the corrosive gas (F, HF, Cl, HCl, SO_2, H_2S, etc) or poisoning substance (Si, Pb, P, Zn, Mn, Ca, etc), it is possible that the sensor is in poor condition in a short time.

*2: In case of using another tachometer (such as AVL DiSpeed490), pinch the detection loop of it by the clamp sensor (SL06003, optional) that is connected to the MEXA-584L.

*3: If either sensor and a CAP8950 sensor are connected to the MEXA-584L at the same time, the input signals from the CAP8950 sensor will be adopted.

*4: For using this software in a PC which supports USB ports only, use a USB/RS232C converter on the market.

7.2 Lambda Formula with O_2 Measurement

For lambda calculation, based upon measurements of CO, CO_2, HC and O_2, the following formula is applied:

$$\lambda = \frac{[CO_2] + \frac{[CO]}{2} + [O_2] + \left\{ \left(\frac{H_{cv}}{4} \times \frac{3{,}5}{3{,}5 + \frac{[CO]}{[CO_2]}} - \frac{O_{cv}}{2} \right) \times ([CO_2] + [CO]) \right\}}{\left(1 + \frac{H_{cv}}{4} - \frac{O_{cv}}{2}\right) \times \{([CO_2] + [CO]) + (K_1 \times [HC])\}}$$

Where

[ ] is the concentration in %vol, for HC only in ppmvol.

K_1 is the conversion factor for HC if expressed in ppmvol n-hexane (C_6H_{14}) equivalent. Its value in this formula is 6×10^{-4}.

H_{CV} is the atomic ratio of hydrogen to carbon in the fuel.

O_{CV} is the atomic ratio of oxygen to carbon in the fuel.

GAST

1 HP Separate Drive Vacuum Pump; Inlet Size: 3/4" NPT, Outlet Size: 3/4" NPT

Item # **4Z469** Mfr. Model # **2067-V108** Catalog Page # **2585** UNSPSC # **40151502**

How can we improve our Product Images?

Compare

Web Price
$1,057.00 / each

One Time Delivery
Auto Reorder

1 ADD TO CART

+ Add to List

Shipping Pickup

Expected to arrive **Wed. Jun 20.**

Ship To **87101** (Change)

Jump to: Replacement Parts

☆☆☆☆☆ Be the first to write a review

Shipping Weight **57.7 lbs.**

Country of Origin **USA** | *Country of Origin is subject to change.*

Note: Product availability is real-time updated and adjusted continuously. The product will be reserved for you when you complete your order. More

PRODUCT DETAILS

Ideal for general continuous-duty vacuum and low-pressure applications. Included coupling and coupling guard allow you to mount pump directly to 56C frame motors.

• Permanently lubricated and sealed bearings
• Self-adjusting, self-lubricating vanes
Note: When used for pond aeration, include the appropriate check valve in discharge line to prevent water from entering pump in case of power failure.

View Less

TECHNICAL SPECS

Item	**Separate Drive Vacuum Pump**	Free Air CFM @ 10 In. Hg	**10.00**
HP	**1**	Free Air CFM @ 20 In. Hg	**1.00**
Compressor Type	**Rotary Vane**	Overall Length	**11.48"**
Hz	**60**	Overall Width	**17.69"**
Inlet Size	**3/4" NPT**	Overall Height	**13.12"**
Outlet Size	**3/4" NPT**	Housing	**Cast Iron**
Free Air CFM @ 0 PSI	**17.00**	Design	**Oil-less**
Free Air CFM @ 10 PSI	**12.50**	Motor Mounting	**56C**
Max. Vacuum	**26.5" Hg**	Standards	**CSA**
Free Air CFM @ 0 In. Hg	**17.00**	Includes	**Coupling and Coupling Guard**

GAST

1/8 HP Diaphragm Compressor/Vacuum Pump

Item # **3KYY6** Mfr. Model # **DOA-P704-AA** Catalog Page # **2585** UNSPSC # **40151502**

How can we improve our Product Images?

Compare

Web Price
$658.00 / each

One Time Delivery
Auto Reorder

1 ADD TO CART

+ Add to List

Shipping Pickup

Expected to arrive **Thu. Jun 21.**

Ship To **87101** (Change)

Jump to: Replacement Parts

Be the first to write a review

Shipping Weight **18.8 lbs.**

Country of Origin **USA** | *Country of Origin is subject to change.*

Note: Product availability is real-time updated and adjusted continuously. The product will be reserved for you when you complete your order.
More

PRODUCT DETAILS

Permanently lubricated, virtually maintenance-free unit offers the versatility of reversible 1/8" and 1/4" inlet and outlet ports. Quiet operation and designed for applications requiring moderate pressure and continuous duty. Oilless for low maintenance.

TECHNICAL SPECS

Item	**Compressor/Vacuum Pump**	Max. Vacuum	**25.5" Hg**
Compressor Type	**Diaphragm**	Max. PSI Cont./Int.	**60/60**
HP	**1/8**	Free Air CFM @ 0 PSI	**1.90**
Voltage	**115**	Free Air CFM @ 20 Vacuum	**0.30**
Hz	**60**	Overall Length	**7-5/8"**
Full Load Amps	**4.5**	Overall Width	**5-1/8"**
Inlet Size	**3/8" Hose Barb**	Overall Height	**8"**
Outlet Size	**3/8" Hose Barb**		

SENSIT® PMD

PORTABLE METHANE DETECTOR

INSTRUCTION MANUAL

READ AND UNDERSTAND INSTRUCTIONS BEFORE USE

SENSIT Technologies

851 Transport Drive
Valparaiso, IN 46383-8432

Phone: 888 473 6748
219 465 2700
Fax: 219 465 2701

Email: info@gasleaksensors.com
Web: www.gasleaksensors.com

Warnings:

- To prevent ignition of flammable or combustible atmospheres disconnect power before servicing.
- Remove and charge battery pack in an area known to be free of combustible gases.
- Use only Sensit Technologies battery pack.
- Service may only be performed by factory authorized service technicians
- Not for use in environments greater than 21% oxygen.

Safety Precautions:

- Read and understand instructions prior to use.
- Always start the PMD in an area known to be gas free.
- Tampering with this product may void the warranty.
- Use only Sensit Technologies approved parts and accessories.
- Never use an instrument known to be damaged, operating unusually, or out of calibration.

For further information contact Sensit Technologies.

Sensit Technologies
851 Transport Drive
Valparaiso, Indiana
46383
USA

Tel: 219/465-2700
Fax: 219/465-2701

Email: info@gasleaksensors.com
Web: www.gasleaksensors.com

TABLE OF CONTENTS

General Description

The Sensit® PMD, referred to as the “PMD”, is designed to detect methane gas from 1ppm up to 100% volume. The PMD may be used for walking surveys and vehicle surveys (when properly installed) for underground natural gas piping systems. Other applications include landfill monitoring and checking piping systems where other interfering gases may provide inaccurate readings.

The PMD senses gas using Infrared (IR) Absorption Spectroscopy in combination with an electronic narrow band pass filter. This technology utilizes an infrared light source with an output that is changed when certain gases absorb the light output. The filter only allows specific light wavelengths to be monitored and measured. The concentration of gas is proportional to the amount of specific IR light absorbed and is displayed in PPM, %LEL and/or %Vol.

The PMD has a large display indicating concentration and other instrument functions such as battery charge and performance. An internal pump provides rapid sampling into the detection chamber. Audible and visual alarms indicate when preset alarms are exceeded. Bluetooth data transmission provides communication of real time and stored data. Optional GPS and Data Logging allow for further recording of time, date and location data.

Accessories

Standard Accessories

Telescopic Survey Probe	Part # 883-00029
Shoulder (Carrying) Strap	Part # 360-00238
Lithium Rechargeable Battery Pack	Part # 871-00017
Universal Wall Charger	Part # 871-00025
Battery Door Removal Tool	Part # 360-00249
Instruction Manual	Part # 750-00045
Hydrophobic Filter Ring Assembly (10 Pack)	Part # 873-00033
Survey Probe Filter (Blue) (1 Filter)	Part # 360-00064

Optional Accessories

Fiberglass Bar Hole Probe	Part # 883-00019
Brass Bar Hole Probe	Part # 883-00018
HD Fiberglass Bar Hole Probe	Part # 883-00021
PMD Manual Calibration Kit	Part # 881-00070
Bump Gas Cylinder (50ppm CH4)	Part # 315-03000 4
Delux Hard Carrying Case	Part # 872-00010
Compact Carrying Case	Part # 872-00013
Shipping Box and Foam	Part # 872-00017
Hot Swap Vehicle Battery	Part # 871-00030
Removable Memory Card	Part # 360-00243
PMD Harness	Part # 870-00046

Replacement Parts

Shoulder (Carrying) Strap	Part # 360-00238
Filter Cap Assembly “O” Rings	Part # 870-00034
Survey Probe Filter (Blue) (1 Filter)	Part # 360-00064

Product Specifications

Operational Specifications

Temperature:	-4 to 122F
Duty Cycle:	~7hours
Response time:	T50 < 3 seconds
Alarms:	Audible - 95db @ 15 inches
	Visual – Red backlight on display
	Visual – Display info
	Visual – Failure indicators
	Settings – PPM and LEL
Power:	Lithium Ion Rechargeable battery pack
	Optional Vehicle power adapter
Pump Flow:	1 lpm
Detection Range:	0-5000ppm
	10–100% LEL
	5-100% V/V

Physical Specifications

Size:	11” x 4.5” x 6.5” (Approximate)
Weight:	6.1Lbs
Construction:	Cast Aluminum/ABS Plastic

Sensor Specifications

IR Sensor:	Wavelength – 3.4m
	Detection Range 1ppm – 100% v/v
	Warm up < 10 min
	Calibration required - 3 months

Product Features

- The PMD is constructed of durable ABS plastic
- The housing is designed to meet IP54 protection
- The PMD is designed to meet Cat 3 Intrinsic Safety requirements
- Battery pack is designed for easy field replacement
- Field or Smart Cal calibration is easily performed
- External filters are inexpensive easy to change
- The LCD display is easy to read
- The PMD uses a simple “Sensit Style” user interface
- Communication with other devices is easy with Bluetooth interface
- Real time GPS is optional
- Real time Data logging with removable storage option

Electronic Features

User Interface

The user interface includes the following features:

- Three button operation
- LED Status indicators
- Sounder
- Photo cell (automatic backlighting)
- IR communication port
- LCD

Button Operation

The Sensit PMD is operated with the use of three buttons below the display.

They are labeled A, B, C.

The “A” button:

- activates/deactivates the instrument
- mutes the audible alarms
- access Smart-Cal communication

The “B” button:

- Accesses the quick menu and user menu
- Digitally adjusts the TICK sound for leak locating

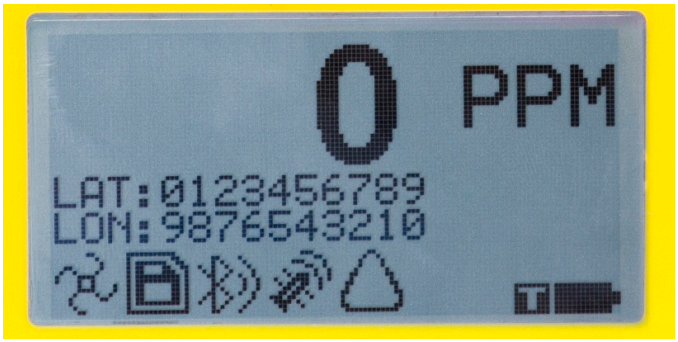
The “C” button:

- Saves displayed readings to the internal memory
- Performs a manual zero.

Display Features

The display provides all information including:

- Gas concentration in PPM, LEL AND %Vol
- Battery voltage status
- Pump Status
- GPS activation and coordinates
- Bluetooth operation
- Data logging operation
- Warning indication
- Tick operation



Icons on the display indicate the status of various functions.

 - Flow OK

 - Flow blocked

 - Alarm not muted

 - PPM alarm muted

 - %LEL alarm muted

 - %GAS alarm muted

 - Warning/trouble/failure symbol

 - Bluetooth On and Connected

 - Bluetooth on but not connected

 - Tick ON

 - Data logging on – flash once for data save

- Data Saved – flash once for manual data save

 - GPS Connected

 - GPS enabled-not connected

Alarm settings

There are 3 adjustable alarm settings.

1. PPM
    a. Default: 10ppm
    b. Low Limit: 0
    c. High limit = 500
    d. Disable PPM alarm: Set the PPM alarm to 0
    e. Alarm: Audible, LED, Red backlight if unit in dark

2. %LEL
    a. Default: 50% LEL
    b. Low Limit: 10% LEL
    c. High limit = 90% LEL (If no autorange to %gas)
    d. Disable LEL alarm: Can not disable this alarm (mute only)
    e. Alarm: Audible, LED, Red backlight if unit in dark

3. %GAS
    a. Default 17% Vol
    b. Low Limit: 5% Vol
    c. High Limit: 50% Vol
    d. Disable %GAS alarm: Can not disable this alarm
    c. Alarm: LED, Red backlight if unit in dark

Adjustment of the ppm alarm is covered in the User Menu portion of this manual.

Housing Features

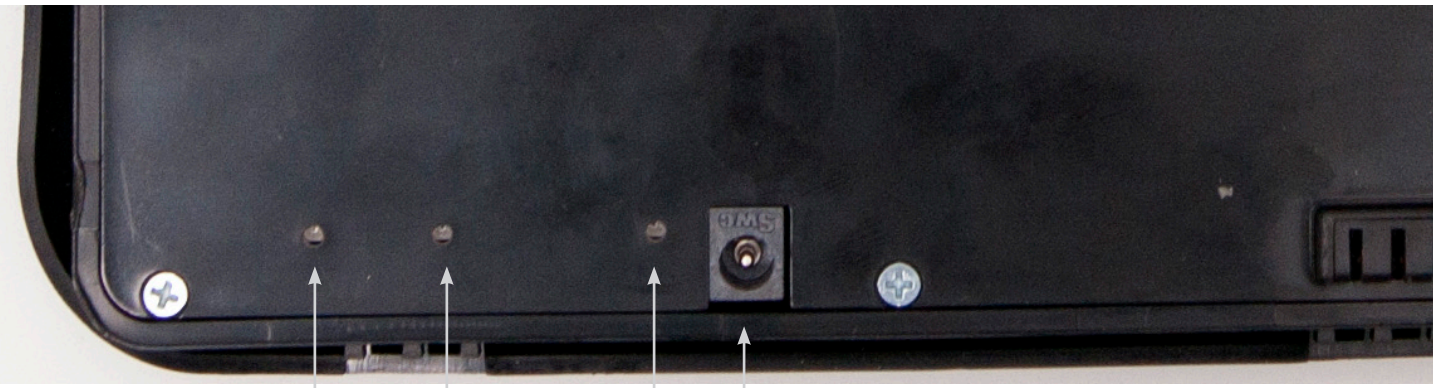
Battery Pack

The battery pack is located on the back side of the instrument housing. The batteries are Lithium Ion rechargeable. The batteries are only available from Sensit Technologies.

To remove the battery pack turn the retaining screws ¼ turn. Pull the bottom of the pack away from the main housing. Recharging of the battery pack requires removal from the main housing.

To replace slide the top tabs of the battery pack into the retainers at the top of the main housing. Push the bottom into place and turn and lock the retaining screws.

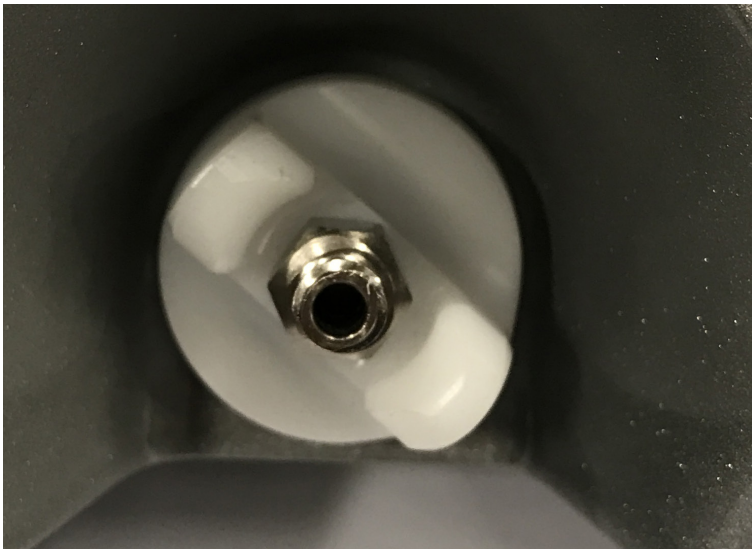
The battery pack has LED's to indicate charge status. Charging should only be performed in an area know to be free of combustible gases.



Gas Inlet and Outlet

Located on the front of the main housing is the gas inlet and outlet. Both are fitted with luer-style connections for easy connection to probe accessories.

The center connection is the gas inlet. To the right is the outlet. Do not block gas outlet.



Shoulder Strap attachment

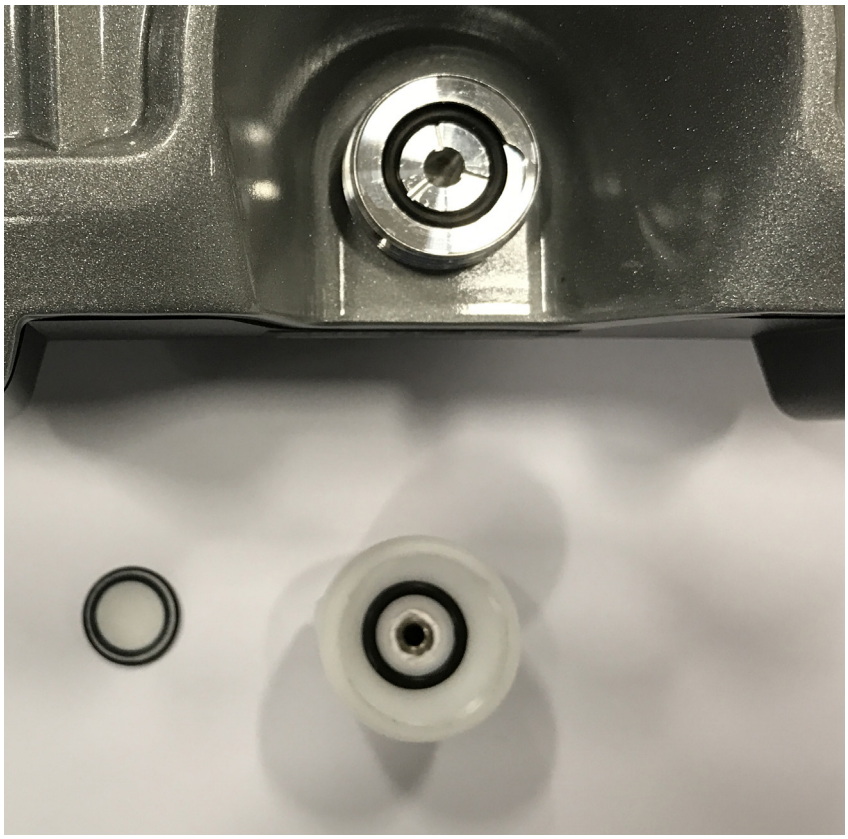
"D" rings are located on each side of the main housing for shoulder strap attachment. Clips on the strap will attach securely.

Hydrophobic Filter Assembly

WARNING: Do not operate without proper filter. Damage may occur to the pump and other internal parts. Only change filter with pump or instrument off.

The gas inlet is protected by a hydrophobic filter.

It is accessed by:
1. Detach any probe assembly
2. Twist and remove filter cap
3. Remove and replace filter disc
4. Check “O” ring inside cap
5. Replace filter cap
6. Performed flow block test



Additional filters are located in each of the accessory probe assemblies.

Operation and Field Use

To activate instrument push POWER button. The following warm-up sequence will occur:

1. Warm-up sequence (a-i) with info below.

    a. Logo
    b. Serial Number
    c. Revision
    d. System Check
        i. LED check
        ii. Backlight check
        iii. Date/Time
    e. Cal due (upcoming) or Cal Past Due
    f. Activation Acknowledgments
        i. Pump
        ii. Dataglog
        iii. GPS
    g. Sensor warm-up (7-10Min) and “Please Wait”
    h. Autozero
    i. Working display

2. Attach the appropriate probe assembly and perform a flow block check. An alarm sound, display indication and flow icon will indicate a failed test.

3. Follow company procedures for performing leak survey/investigation

4. If the alarm setting has been exceeded press and release the “A” button to disable the alarm. The alarm sound will automatically reset when the concentration has gone below the threshold value. Secondary alarms at higher concentration will activate when values are exceeded. Press and release the “A” button again to mute secondary alarms. During any alarm, the display back light will be RED in color.

5. Check filters daily for best results.

6. Battery power is displayed using a battery voltage icon. Full battery is 12.0v. BAT LOW VOLT will be displayed at 8v when insufficient battery power is available.

7. To turn off or put into standby mode push and hold the “A” button. It will display “SHUT DOWN” on left side and “STAND BY” on right side of the display. Press the ‘A’ button to turn the instrument off. Press ‘C’ to put unit in standby mode which will reduce power consumption and will allow you to reduce the warm up time to approximately two minutes. We recommend using stand by mode for less than 1 hour.

QUICK MENU

Press and release ‘B’ button. This will provide access to the following functions. Press the “C” button to scroll through the options. Use ‘B’ button to select. Use ‘B’ button again to turn it OFF or ‘C’ button to turn ON. Press ‘A’ button to select your choice and exit menu.

1. TICK – Audible leak detection mode. NOTE: Activating the tick will disable sound alarm.

    a. When activated a tick will be heard every second. Frequency of tick will increase as gas concentration increase.
    b. Press and release ‘B’ button will reset the tick frequency to 1 tick per second. The tick frequency will increase if gas concentration increase from that concentration.
    c. To turn the tick off, press and release ‘A’ button. Press and release ‘A’ button again to activate the alarm sound.

When viewing the following selections Use ‘B’ button to select. Use ‘B’ button again to turn it OFF or ‘C’ button to turn ON. Press ‘A’ button to select your choice and exit menu.

2. BH Test – Bar hole test function
3. PUMP - Use ‘B’ button to select. Use ‘B’ button again to turn it OFF or ‘C’ button to turn ON. Press ‘A’ button to select your choice and exit menu.
4. GPS – Real time GPS X/Y coordinates
5. SmartLink - Use Bluetooth to download logs (Calibration, Quick Cal, Session, Barhole, Autologs)
6. Warning - Use this feature to list current failure mode.

Bluetooth Activation

When the Bluetooth is activated the display readings can be transmitted to any device capable of receiving Bluetooth data. The data may also be viewed by using “Hyper Terminal”. The website is www.lgraeve.com

Bluetooth Passkey: 5 Digit Serial Number

Serial Communications Settings:
Bits Per Second: 57600
Data bits: 8
Parity: None
Stop bits: 1
Flow control: None

DataStream can be adjusted to send data every 1-10 sec. you can find settings to change this in Expert Menu -> DataStream. You need to turn DataStream ON in User Menu.

Once connected to the Bluetooth device, PMD sends the 7 digit PPM reading.

USER MENU

To access the user menu push and hold the “B” button until USER MENU is displayed. From this menu the following features can be viewed by pressing the “C” button to scroll through the options. Enter the selection by pressing the “B” button and adjusting by using the “C” button or the onscreen prompts. Pressing the “A” button repeated will return you to the working display.

Date and Time View the date and time.
Time is in 24 hour format. Date is mm/dd/yy format.

Print Menu Allows access to print menu for calibration and operational sessions.

Bump Test Perform timed test for gas response in ppm range. Pump may be selected ON or OFF for this function.

Calib Menu Calibration to Zero Air, 1000ppm, 2.5% and 100% methane gas concentrations.
For instruction refer to CALIBRATION section of this manual.
- Zero Air - To Set Zero Point
  Pump On / Off
  Onscreen Instruction
- 1000PPM - To calibrate 1000ppm level only
  (Zero Air calibration required first - automatic)
- 2.5% V/V - to Cal 2.5% (50 LEL) CH_4 Only
  (Zero Air calibration required first - automatic)
- 100% V/V - to Cal 100% (100 LEL) CH_4 Only
  (Zero Air calibration required first - automatic)
- Full Calib - Automatically sequence zero, 1000, 2.5% V/V, 100% V/V
  (This updates Cal Due)

Datalog Activates the data logging system. (If Activated w/memory card)

Data Stream Activates real time data streaming of display readings every second to another recording device using Bluetooth. Settings on page 13.

Alarm PPM Adjustment for PPM alarm value.
Setting at 0 disables alarm.
Range is 0-500ppm

Set Clock Adjust date and time.

View Sess Log View manually saved data.

View BHLOG View the bar hole test logs (If Activated).

View Auto View Autolog data of operational peak values.

View Cal Log View calibration log.

QCal Log View recording of individual calibration (Not Full Calib)

Calibration Check

To verify the proper operation of this instrument apply a known concentration of 50-1000ppm methane to the sample system prior to use.

This is not a required process but is recommended if the product has not been used for more than 30 days.

Calibration

The PMD requires calibration every 3 months. An automatic reminder will notify the user that calibration is due at start up.

Calibration can only be performed if the instrument has been operational for 30 minutes.

To calibrate the area must be known to be gas free. If there is methane in the area a bottle of zero air will be necessary. Other gases required include 1000ppm, 2.5% and 100% methane (pipeline gas is also acceptable). Some gases can be calibrated individually. Contact SENSIT Technologies Service Department for more information.

Calibration is performed with the pump off if there is no access to demand flow regulators for the calibration bottles. Turn-off is selected prior to calibration.

Calibration is performed through the User Menu. Using the “B” button access the User Menu. Use the “C” button to scroll to “Calib Menu”.

To begin press the “B” button. If the instrument has not operated for 30 minutes a countdown timer in seconds will be displayed. When the proper amount of time has been met the display will show “Proceed”. Press any button. A beep will be heard.

Select Cal Type and follow on-screen prompts. Full Calib is reccomended.

Apply zero ppm methane or clean air. Press “C” button to begin zero air calibration. Display will show “waiting for stability” followed by “success” when completed. Press any button to continue.

Display will read “please apply 1000ppm methane”. Attach and apply 1000ppm methane. The process requires 1-5 minutes. Searching OPT TEMP will be displayed, then display will show “waiting for stability” followed by “success” when completed.

Display will read “please apply 2.5% methane”. Attach and apply 2.5% methane. The process requires 1-5 minutes. Display will show “waiting for stability” followed by “success” when completed.

Display will read “please apply 100% methane”. Attach and apply 100% methane. The process requires 1-5 minutes. Display will show “waiting for stability” followed by “success” when completed.

Upon completion press any key to exit to working display. Activate the pump and allow to clear prior to turning off. The calibration reminder will automatically update after successful calibration.

Adjustable Features (password protected)

Contact Sensit Technologies to gain access to the following adjustable features not in the user menu.

Service	**Contrast:** Adjust the display contrast as needed. **Quick Scan:** Optimum Temp Adjust (1000ppm required) **Orientation Cal:** Calibration of lamp output in different positions. **Cal Flow:** Setting flow alarm
Tick SENS	Lo, Med, or High
Alarm %LEL	Adjust the LEL alarm value. Default is 50%.
Alarm %V/V	Adjust the point when the alarm deactivates. Default is 17%.
Show SESS	Allow display of manually saved data. Default is off.
Show BHLOG	Allow display of BH tests. Default is off
Show AUTO	Allow display of Autolog data. Display is off.
BH Time	Set the time in seconds for duration of the bar hole test. Default is 15 seconds.
Purge Time	Set purge time for instrument prior to shut down. Default is 10 seconds.
Standby	Time of inactivity or lack of motion in minutes that will cause the instrument to automatically go into low power mode. Default is off.
Shutdown	Time in minutes that shut down will occur when in standby mode. Default is 60.
Bump Limit	Concentration of gas to be acceptable when performing a bump test. Range is 5 – 1000ppm. Default is 800. Set Lower and Upper Limit.
Bump Time	Time required in seconds for unit to pass a bump test. Range is 10-60. Default is 45.
Log Period	Time between Datalog points in seconds. Range 1-60. Default is 1.
Data Stream	Time in seconds for data to be streamed through Bluetooth communication. Default if 1 second.

Adjustable Features (Continued)

Rest UCal	Reset cal data to factory settings (Password Protected)
Set Cal Due	Time Interval (90 Default)
Cal Due Ack	Requires button push after Cal Due reminder (default off)
DISP Callog	Last 5 calibration records
PPM Option:	PPM Auto range to LEL. Default is on.
PPM Handoff:	Handoff from PPM to LEL or %V/V setting. (default 5000)
% LEL Option:	LEL from 0.1-100%. Default is On
100% LEL Equiv:	Set LEL limits from 4.0 – 5.0% gas volume. Default is 5%.
PPM+%LEL:	Display both PPM and %LEL. Default is Off
NG Factor:	Automatic calculation for low methane pipeline gas. (default 100)
UCal Date	Date of last full user calibration
Erase Auto	Erase Autolog
Erase Sess	Erase manually saved data Log
Erase BHLog	Erase bar hole test log
SCal Pump	On/Off During Cal (for each gas type) when calibrating on the cal-station
Rezero REQD	Downdrift Alert, On/Off, Value 5 Default
Language	Select language for display
Auto Bump	Require bump test before use (default off, adjustable 1-30 days)
Erase Bump	Erase Auto Bump Log

Saving SD Card Data Log Information

Remove SD Memory Card from inside the battery compartment.
Install SD Memory Card in computer.
Save File in desired format and location. Preferred format is .kml

GPS Data Conversion & Coordinate Mapping

GPS Data conversion and mapping can be accomplished using Smart-Link Data Viewer Software and Google Earth or gpsvisualizer.com

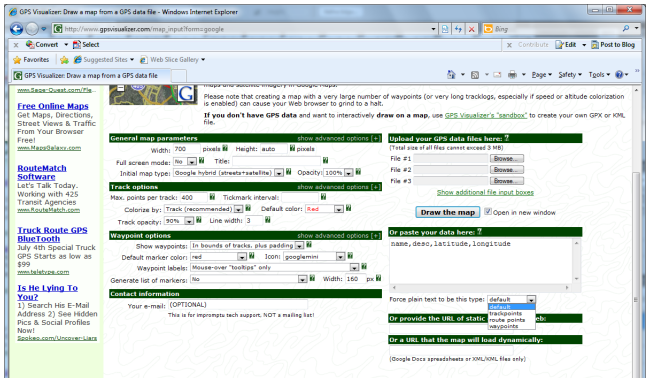
1. Using SmartLink select the desired reports.
   (See “How to use” and “Reports” section of SmartLink Help file for more information.)

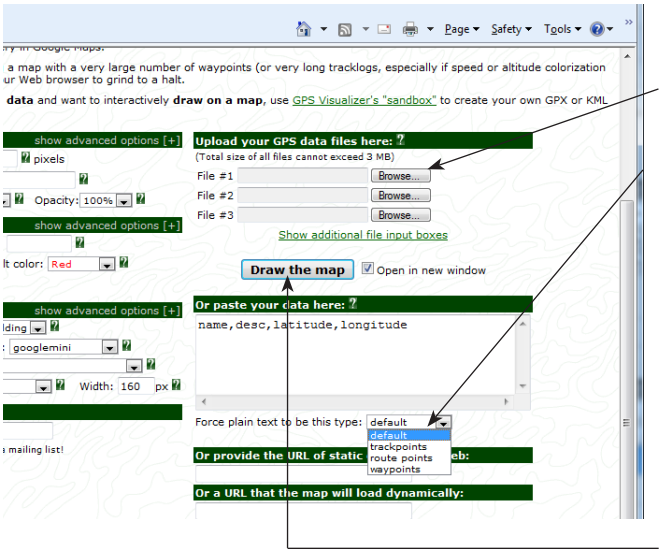
2. Click “Save Report” button. Save report as format .kml format.
   This format will only save log information for which valid GPS coordinate information is available.

3. Google Earth must be installed (Free Download).
   Double click the .kml file.
   It will open Google Earth and load the map.

   Note: If Google Earth is not installed, proceed to number 4.

4. Go to: **http://www.gpsvisualizer.com/**
   Select “**Google Maps**”.





Import your .kml file:

1. Using browse button, select the file you wish to view.

2. Select the map type.

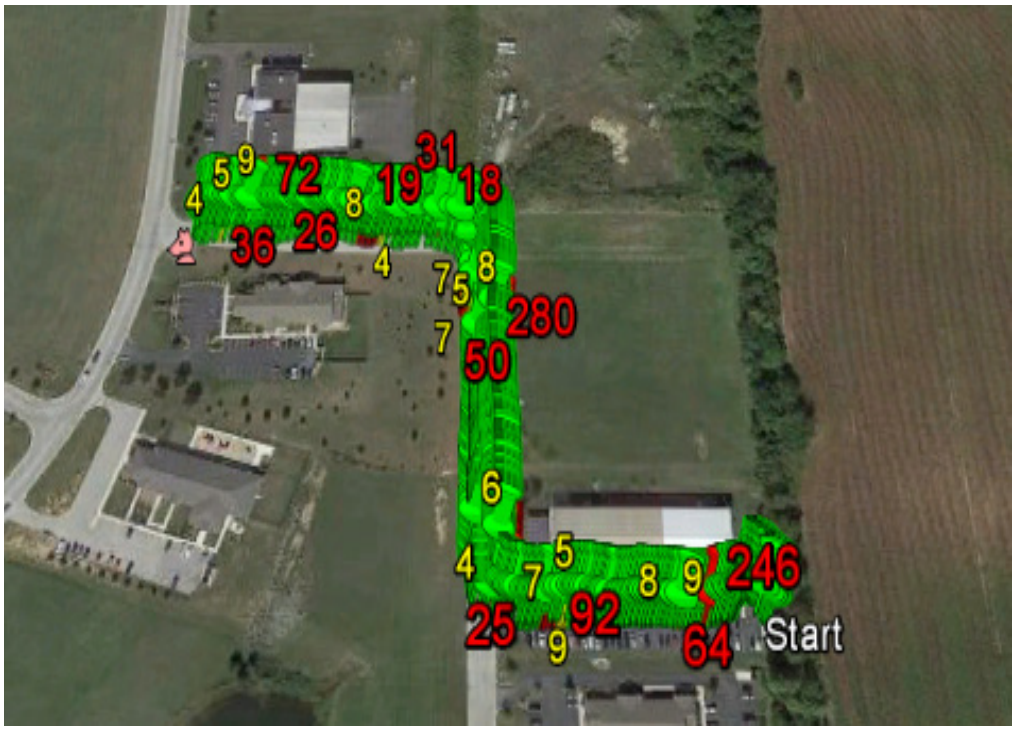
Way-points: To display coordinates, gas concentration detected and time at specific locations. It is best to use with Session-log, Bar-hole log and Auto-log.

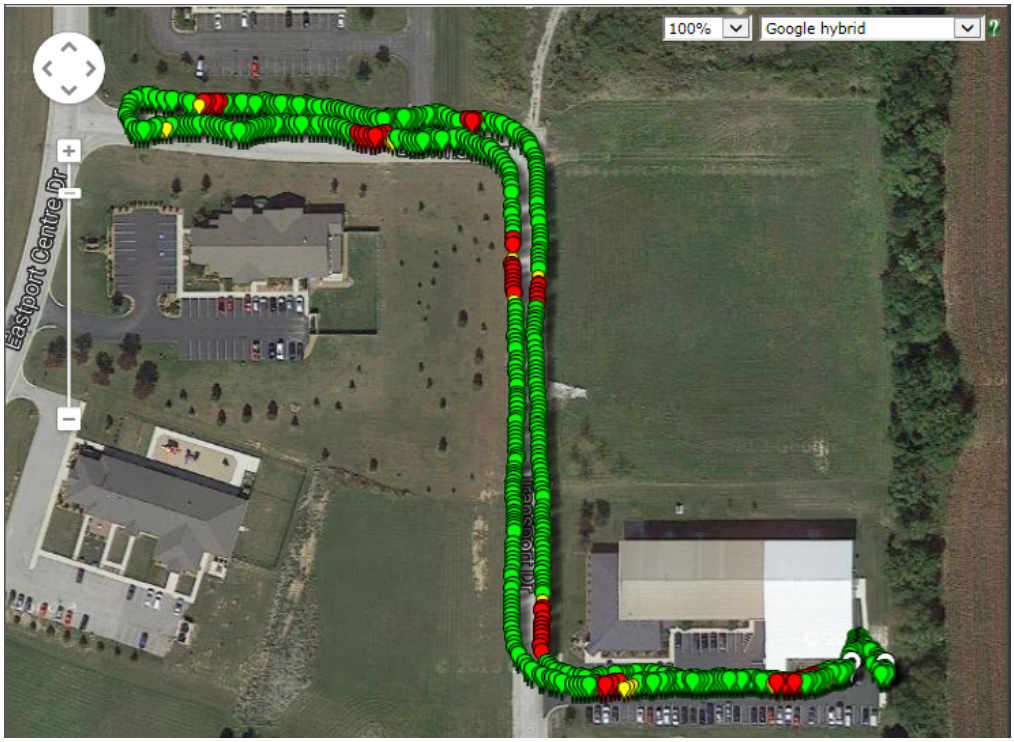
Route points: The “route” would represent the road, trail, path, etc. that you have taken. It also display gas concentration detected and time at specific locations. It is best to use with Data-log to view area surveyed.

3. Click “Draw the map” button.

GPS Data Conversion & Coordinate Mapping

Sample of the data log report is displayed below.





Warranty

Your Sensit PMD is warranted to be free from defects in materials and workmanship for a period of two years after purchase (excluding calibration). If within the warranty period the instrument should become inoperative from such defects the instrument will be repaired or replaced at our option. This warranty covers normal use and does not cover damage which occurs in shipment or failure which results from alteration, tampering, accident, misuse, abuse, neglect or improper maintenance. Proof of purchase may be requireds before warranty is rendered. Units out of warranty will be repaired for a service charge. Internal repair or maintenance must be performed by a Sensit Technologies authorized technician. Violation will void the warranty. Units must be returned postpaid, insured and to the attention of the service department for warranty or repair.

This warranty gives you specific legal rights and you may have other rights which vary from state to state.

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MADE IN THE USA
WITH GLOBALLY SOURCED COMPONENTS